

**BASIC (BIOLOGICAL AGRICULTURE SYSTEMS IN COTTON):  
A COTTON PEST MANAGEMENT INNOVATORS GROUP IN THE  
NORTHERN SAN JOAQUIN VALLEY**

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## **Abstract**

The BASIC Pest Management Innovators Work Group in cotton was formed in 1995 to test and disseminate innovative ideas in cotton chemical use reduction. The work group does this through an organized outreach program made up of cotton farmers, pest control advisors, agronomists, and U.C. Farm Advisors and researchers. The scope of the project in 1998 was seriously affected by El Niño events: total acreage, total numbers of participating growers, planting dates, and yields were all affected. In 1998, our scientific investigation was focused on biologically based management of arthropod pests using a multi-component approach. Growers using this approach (“BASIC growers”) were able to reduce their insecticide and miticide use by 90% in one year of study (1997). We found more lygus and mites in BASIC than in control fields, but aphid numbers were similar to those in control fields. Predatory insect numbers were elevated as well. We did not find increases in square shedding (caused by lygus bugs) in BASIC fields. However, BASIC growers had lower yields than did control growers (BASIC 2.1 [1997] and 1.4 [1998] bales per acre; control 2.9 [1997] and 2.3 [1998] bales per acre). When organic and non-organic BASIC results were separated, only organic BASIC yields were significantly lower than yields of control growers (organic BASIC 1.9 bpa, 1997; 1.3 bpa, 1998). Using cost of production data from 1997, we found that operational costs per bale were almost 50% higher for organic BASIC growers than for control growers. Operational costs of production per bale for non-organic BASIC growers were not notably different from those for control growers.

## Executive Summary

The objectives of this project are divided into four major components. The objectives are as follows, organized with their associated methodologies, results, and conclusions.

### Objective 1. *Recruit growers and enroll production units (fields).*

With the collaborative support of the U.S. EPA, we formed the BASIC Pest Management Innovators Work Group of cotton growers in the northern San Joaquin Valley (Merced, Madera, and northern Fresno counties). In the program, innovative growers enroll production units in a supervised pest management program of monitoring and biologically based pest management alternatives, including beneficial insect release, trap and insectary plant cropping and mechanical weed control. In 1998 the goal was to retain 1997 growers and to expand the program to additional growers. We recruited 14 farmers to participate in the program, with a total of 13 enrolled fields and 14 control ("check") fields. Seed variety, planting date, and willingness to share information on production practices were verified, and a pest management program consisting of five components (with exceptions) was established. Planting delays caused by El Niño and low total acreage of cotton in 1998 led us to make exceptions with several of the cooperating growers for two components of the program.

### Objective 2. *Monitor enrolled fields and compare potential yield limiting factors with conventional control fields.*

Major arthropod pests and natural enemies were monitored throughout the season using both leaf samples and sweep net samples. Spider mites were more abundant in BASIC fields, but there were no treatment differences in lygus numbers (summed over the whole season) or aphid rank. Beneficial insects were significantly more abundant in BASIC fields than in control fields.

We monitored plant development from early June until defoliation, in mid October, measuring vegetative and fruiting parameters critical to cotton production. Immediately prior to harvest we took one final plant sample, measuring all in-season development parameters as well as total numbers of open bolls and green bolls at all positions on the plant. At the time of this final sample we also estimated per-acre cotton yields for each field. Yields were significantly lower in BASIC than control fields, due almost entirely to the organic BASIC component. Organic BASIC fields were planted less densely, and lost a higher percent of plants during the season, than non-organic BASIC or control fields.

Soil samples were taken on each enrolled and control field prior to planting, and foliar nutrient tests were done four times during the production season (first square, first bloom, peak bloom, and first open boll stages, corresponding to late June, mid-July, mid-August, and mid-September, respectively). Tests from these samples have yet to be analyzed. In a prior study comparing organic and conventional cotton production, we found no consistent soil or foliar nutrient differences between the two systems.

Objective 3. *Demonstrate key techniques necessary to overcome yield-limiting factors via auxiliary, replicated commercial sized plots, in on-farm experiments emphasizing: (1) lygus bug control with alfalfa or non-crop vegetation and alternative watering methods; (2) release and tracking of beneficial insects (green lacewings) for biological pest control; and (3) alternative weed control practices with new cultivators, mowers, and flamers.*

Competitive grant proposals submitted in 1997 for 1998 research projects with U.C. researchers Dr. Daniel González (lygus control methods), Dr. Tim Prather (alternative weed control practices), and Dr. Bill Weir (lygus control methods) were not funded by extra-mural sources. Using funds from the current grant, we conducted a preliminary experiment on lygus bug control using alfalfa as trap crop vegetation, and found that there is a potential benefit to planting cotton next to alfalfa fields in terms of lygus control. Weed control experiments, initiated in 1997, will be continued in 2000 under separate funding. With the help of the US Environmental Protection Agency and the Sustainable Cotton Project, we are currently collaborating with Dr. Marc Buchannan in the design and implementation of an experiment studying winter cover crops and their impact on in-season nutrient dynamics and availability.

Objective 4. *Document the three year economic and energetic costs of the BASIC Pest Management Systems.*

By the end of 1996, we had completed compiling data on general economics and energy use of cotton production in California. Using this data and information from interviews with participating growers, we estimated 1996 operational costs of production for both BASIC and conventional control growers in our study, which we presented in an earlier progress report (March 1998). We limit our economic analyses to operational (or farmgate) costs, not including costs which (a) may be incidentally different between individual growers (e.g. cash and non-cash overheads); or (b) are impossible to accurately estimate (e.g. risk associated with alternative production methods; additional marketing costs for organic cotton). We found that operational costs per bale were almost 50% higher for organic BASIC growers than for control growers. Operational costs of production per bale for non-organic BASIC growers were not notably different from those for control growers. We have not yet completed the energetic analyses.

Objective 5. *With the collaboration of the US-EPA and the Sustainable Cotton Project, disseminate these monitoring and experimental results to the BASIC Work Group in monthly technical meetings during the growing seasons and to the cotton farming community via meetings, farm field days and publications.*

We held one farmer breakfast meeting and two field days in 1998, documentation of which is included in Appendix B. In addition, we sent three field updates to growers during the production period (July, August and October) (a sample update is included in Appendix C). In these updates we provided a summary of plant and arthropod population parameters to date in the group as a whole; showed graphs comparing these values in BASIC and control fields; and provided charts detailing the performance of each individual field. All of the information was provided anonymously, with fields identified by a code known only by that particular grower and by BASIC researchers. Several growers reported that these updates were very useful to them, but would be even more useful if they were provided more immediately. As a result, we now report insect monitoring results to growers one to two days after sampling.

## Body of Report

### a. Introduction

Between 800,000 and 1,000,000 acres of cotton are planted each year in the San Joaquin Valley (CDFA, 1996; USDA, 1999). Cotton not only is one of the most widely planted California crops, it also consistently ranks among California agriculture's three largest overall users of pesticides (CDPR, 1996). Over 17 million pounds of pesticide active ingredients were applied to cotton in 1996 (CDPR, 1997), and five of the nine most used of these pesticides are recognized carcinogens, according to the State of California's Proposition 65. Moreover, three heavily used cotton chemicals, Chlorpyrifos, Trifluralin, and Proparagite, are routinely detected in biologically active concentrations in San Joaquin Valley rivers (USGS, 1996). Aldicarb, for example, one of the most widely used cotton pesticides (CDPR reports 350,500 pounds used in 1995) has been banned in several states in the US because it has so frequently been detected in ground water (US EPA, 1988). Cotton pesticides have also been identified as the largest agricultural contributor of volatile organic compounds (VOCs) in California (Tim Hatten, US EPA Region 9, pers. com.). Work focused on developing and demonstrating pesticide use reduction techniques in cotton can reduce air pollution and surface and ground water pollution, and as well as reduce risks to human health.

The California cotton production industry ranks second in cotton production in the nation with over one million acres of irrigated cropland. This comprises about 15% of the United States cotton production, and about 4% of the global total. Cotton is the sixth largest contributor to total farm income in the state, and regularly has a gross value of approximately \$1 billion in seed and lint (CDFA, 1996). Production in Merced, Madera, and Fresno counties comprises nearly half of California's total cotton harvest.

At the same time, California cotton is one of the largest users of total agricultural pesticides of any commodity produced in the state. In each production year since 1970 (the first year of statewide pesticide use reporting), California cotton farmers have ranked as either the first, second or third highest users of pesticide active ingredients (e.g. CDPR, 1996). Pesticide use reports illustrate that California cotton is still highly dependent on synthetic pesticides. In 1995 over 17 million pounds of pesticides were used, and cotton led all state crops in the total amount of insecticides, desiccants, and defoliants used (CDPR, 1996). Significant amounts of herbicides, miticides, and other pesticides are also used. Some commonly used cotton pesticides are classified by CAL-EPA as High Priority Risk materials indicating possible future regulatory action. Rising costs of inputs and impacts of environmental regulations, including pesticide regulatory pressures, have stimulated new interest in cotton production systems which limit or do not require conventional synthetic pesticides and fertilizers as inputs (CIRS, 1993).

During the 1960's, the University of California launched a major program of cotton research and outreach in the San Joaquin Valley which led to the development of the Integrated Pest Management (IPM) concept. Although this has been very successful both biologically and economically, the use of chemical herbicides, fungicides, nematicides, growth regulators, and defoliants has kept the total annual use of cotton chemicals relatively high. The BASIC Pest Management Innovators Work Group expands the demonstration and implementation of innovative pest control strategies designed to reduce or eliminate the use of synthetic pesticides and fertilizers. Many of the production systems practices relevant to this goal are reviewed in the western region cotton IPM manual (DANR, 1996) and were also compiled by CIRS (1992, 1993).

The pest management techniques used by innovative cotton growers in the northern San Joaquin Valley range from monitoring efficient pesticide- based programs to biologically-based transitional and organic management systems using organically acceptable inputs only. With such a broad spectrum of reduced risk practices used, it is clear that many growers have begun to consider limiting or completely eliminating pesticides in cotton production. There are a variety of reasons motivating this shift; these include potential pest resistance, non-target effects, human health concerns, and environmental impacts. The BASIC Pest Management Innovators Work Group seeks to coordinate and expand work which is currently being done along these lines by growers in Merced, Madera, and Fresno Counties.

Cotton growers use alfalfa, tomatoes, oats, wheat, and fallow, as well as cover crops and specialty crops (vegetables, garlic, etc.) in rotation with cotton. Cotton has normally been grown in a two-year rotation with the selected annual rotation crops. A well-planned rotational program is essential for the avoidance of soil disease, weed, nematode, and nutrient problems. Rotations to non-host crops or fallow have successfully reduced or eliminated the use of nematicides and fumigants for nematode and disease control in California cotton (Johnson and Goodell, 1988, DANR, 1984).

Compost can be used to effectively diminish fertilizer use, while inoculating the soil with beneficial organisms, building organic matter, and reducing or suppressing certain soil pests and diseases. Some cotton growers presently use composted manures as fall-applied fertilizers. Cotton grown with fall-applied composted chicken manure has successfully produced cotton yields as high as 2.7 bales/acre in a normal weather year (Swezey, 1995). While measures of fertility, tilth, and microorganismal activity in soils are essential components of the overall monitoring program, actual cotton petiole sampling has shown that no essential nutrients are limiting under a compost-based fertility program (Swezey, 1994b).

Cotton growers often maintain field strips of native or planted vegetation as beneficial insect habitats in which native predators are conserved and/or predators are released in the early spring. These predators (e.g. lacewings, predacious mites) colonize early cotton plantings and predators have been observed in increased numbers in cotton plantings not treated with insecticides when compared with conventional acreage treated with insecticides (Swezey, 1994 a). Habitat strips can be established without sacrificing production acreage by planting the strips in alleys, ditch banks, reservoir banks, road margins and stream margins. Seed mixtures are available which combine a variety of plants attractive to beneficial insects found in cotton fields.

The principle arthropod pest of cotton in the northern San Joaquin Valley is the lygus bug (*Lygus hesperus*); mites, aphids, and caterpillars only occasionally cause serious damage in the region. Lygus bugs can be suppressed by strip-cropping the preferred host, alfalfa, as a "trap" crop (Stern, 1969; Sevacharian and Stern, 1974), introduction or conservation of natural enemies, possibly in strip-cut alfalfa or non-crop vegetation (Rakikas and Watson, 1974; Leigh and González; Fleischer and Gaylor, 1987), and alternate-row watering practices to discourage excessive (rank) growth.

The BASIC pest management program in the northern San Joaquin Valley encourages innovative farmers to develop knowledge and skills to time various operations and practices which can reduce or substitute for chemical use. The evolution of a specific BASIC production technology will require experience and understanding of how management decisions are made in the selection of alternative practices. The systematic innovation, organization, and documentation of the BASIC program will provide credibility and quantifiable data for other interested growers.

#### b. Materials and Methods

*Growers and treatments.* We recruited 14 farmers (5 new, 9 retained from 1997) to participate in the program, with a total of 13 enrolled fields and 14 control fields (8 growers for each treatment; two of the growers had fields in both the BASIC and the control treatment). Seed variety, planting date, and willingness to share information on production practices were verified. We continued the pest management program conducted in 1997, which included five components: (1) reduction or elimination of early-season insecticide and miticide spraying; (2) extensive monitoring and updates on production fields; (3) lacewing releases for pest control; (4) location adjacent to at least one alfalfa field; and (5) early planting date. In 1998 we had to modify this program in two ways. First, we had to accept many fields which did not include the fifth component, because most cooperating growers had El Niño-caused planting delays. Secondly, the low total acreage of cotton planted (also due to El Niño) left us with little choice about the fourth component, field location, so some of the enrolled fields were not adjacent to alfalfa fields. As a partial compensation, three of these fields were intercropped with cowpeas, either on the field edge or in strips through the field.

*Nutrients.* Soils in each BASIC field were monitored using a pooled sample of at least 10 sub-samples per plot to determine organic matter content, total N, CEC, micronutrients, pH, bulk density, Ca, Mg, ammonium and nitrate N, available P and K, and soil enzymes.

At each of four seasonal sample dates (first square, flower, green boll, open boll) macronutrients N, P, K, Ca, Mg, and S and micro nutrients Fe, Mn, Cu, Zn, and B were analyzed in leaf petiole samples.

*Plant development.* At the start of the production season we determined planting density by counting the number of cotton plants in four 1/1000th acre linear row samples per field (one sample in each of the four quadrants of the field). This measure was taken again directly prior to harvest to assess in-season plant loss. During the production season we monitored plant phenology and growth response at bi-weekly intervals using a standard twenty-plant sample methodology (CALEX 1991) in each enrolled BASIC field and associated conventional control field. These plants were mapped in the field, using University of California Cotton Plant Mapper software. We measured plant height, number of vegetative and fruiting branches, retention of squares or bolls on the top five and bottom five first position fruiting branches, and number of

nodes above the first position white flower (a measure of plant maturity). This field data were formatted and the information reported to each BASIC grower and used to assess actual field conditions. These reports were logged for season-long evaluations. At the end of the season, directly prior to harvest, we used the same twenty-plant sample methodology for final plant mapping. In addition to the in-season variables, for this final mapping we also recorded the number, position, and maturity (i.e. green or open) of all bolls on each plant.

*Insect populations.* Key pests and beneficial insects were monitored from leaf and sweep net samples taken in the fields throughout the season, as recommended in the UC-IPM cotton guidelines (DANR, 1996). Sweep net samples (50 180-degree sweeps per sample; one sample in each of the four quadrants of each field) were taken twice weekly from mid-June to mid-September, and were used to monitor lygus bugs and generalist natural enemies and record their life stage (nymph, larvae, or adult). Natural enemies included minute pirate bugs (*Orius tristicolor*), bigeyed bugs (*Geocoris* spp.), damsel bugs (*Nabis* sp.), lady beetles, spiders, assassin bugs (*Zelus* sp.), and lacewings (*Chrysoperla* spp.). At the end of the season, values recorded for each insect species in each field were summed over all weeks of sampling to get a total abundance over the whole season for statistical analyses. Corrections were made for missing data, and samples taken before and after the critical period of lygus damage were omitted when summing lygus abundance.

Leaf samples, taken from early June until mid-October, were collected from 20 mainstem leaves eight nodes down from the plant apex every other week (five leaves from each of the four quadrants of each field). The leaves were examined for spider mites (*Tetranychus* spp.), aphids (mostly cotton aphid, *Aphis gossypii*), western flower thrips (*Frankliniella occidentalis*), and eggs and juveniles of the most common natural enemies. Spider mite populations were measured both as a rank, which is a measure of total spider mite numbers in the fields, and as percent infestation, which is a measure of the distribution of mites within the fields. Mite rank is a log scale, with rank of 1 corresponding to zero mites, 2 corresponding to 1 to 10 mites per leaf, 3 corresponding to 11 to 100 mites per leaf, and 4 corresponding to over 100 mites per leaf. Aphid populations were recorded using the same rank measure. Thrips were recorded as either present (a ranking of 1) or absent (a ranking of 0) on each leaf.

To determine the impact of adjacent alfalfa fields on lygus and natural enemy populations in cotton, we compared sweep sample results in three BASIC and three conventional control fields adjacent to alfalfa (not including seed alfalfa) with results in three BASIC and three conventional control fields not adjacent to alfalfa. We also used sweep net samples (two 50-sweep samples per field) to determine lygus and natural enemy numbers in the alfalfa fields.

*Cotton yield and quality.* At harvest, we hand-harvested all open and green bolls from one randomly-selected 1/1000th acre linear row sample in each of the four quadrants of each field. Hand-harvest seed cotton (lint + seed) yields were corrected for seed weight and harvesting efficiency to provide an estimate of lint yield. Actual yield, turnouts [turnout = (ginned lint / seed cotton) \* 100%], and fiber quality were documented from weights and gin ratings of bales harvested from each field. The most important measures of fiber quality are fiber length, strength, and micronaire (width); leaf trash content; and color grade, which measures fiber staining. In our analysis, we calculated the percentage of bales of each fiber grade in each field. To simplify analyses, we grouped bales of similar grades. We grouped bales of the three best grades, which are, in descending order, 11 (“good middling”), 21 (“strict middling”), and 31 (“middling”); the

three next best grades (41 “strict low middling”, 51 “low middling”, and 61 “strict good ordinary”) and then all other grades, which carry various levels of spotting and staining.

*Production costs.* Operational costs of production were determined from grower interviews. Results from the 1997 production season are reported here; some growers’ records from the 1998 season are not yet available, so 1998 results will be included as an addendum to this report at a later date. Growers reported material, water, labor, and mechanical inputs for enrolled and control fields. When necessary, costs and application rates of materials were obtained from other sources. Ginning costs were not included; for many growers, ginning costs are paid by the gin in exchange for cotton seed from the cotton ginned.

All comparisons between BASIC and control field and gin data were analyzed by one-way, single factor analysis of variance (F ratio) tests, transforming data if necessary to equalize variances. Rank tests (Kruskal-Wallis) were used to analyze data which were not normal following transformations.

### c. Results

#### *Plant Development*

*Plant density differences between treatments.* In both the 1996 and 1997 production season, results were potentially confounded by density differences between the treatments. In 1996, the organic component of the enrolled BASIC fields were on average planted at 30,000 plants per acre, while control fields and non-organic BASIC fields were on average about 50,000 plants per acre. In 1997, organic and non-organic BASIC fields were both planted at a lower density than were conventional control fields (organic BASIC, 39,000 plants per acre [ppa]; non-organic BASIC, 42,500 ppa; control, 58,800 ppa), and organic BASIC fields lost more plants during the season than did non-organic BASIC fields, thus stratifying treatments further. Organic planting densities were higher in 1998 (43,000 ppa) than in prior years, but were still lower than densities in control fields (48,000 ppa) or in non-organic BASIC fields (49,000 ppa). Plant loss during the 1998 season was significantly greater in organic BASIC fields (14% loss) than in non-organic BASIC fields (3.7% loss) or control fields (2% loss). None of the other differences was statistically significant.

*Plant development.* There were no significant treatment differences in height, number of vegetative nodes, time to cutout [measured as nodes above white flower], or retention of the top five or bottom five fruiting positions (Figures 1a - 1e; bars show one standard error of the mean). On the final two sampling dates there were significantly more nodes in BASIC fields than in control fields (Figure 1f). On the final sampling date of the season, there were near-significant differences in number of fruiting branches between the treatments ( $p = 0.09$ ); BASIC plants had approximately three more fruiting branches than did plants in control fields (Figure 1g). Other differences were not statistically significant.

At the end of the season, organic BASIC plants were notably taller than non-organic BASIC plants (Figure 1h), and non-organic BASIC plants had more vegetative nodes and fewer fruiting branches than organic BASIC plants or conventional plants. The total number of open bolls (Figure 1j) did not differ between treatments, but there were more first position and fewer outer position (“3rd +”) open bolls in the conventional than other treatments. Organic BASIC plants had more green (unopened) bolls than either the non-organic BASIC or conventional plants.

### *Insect Populations*

*Sweep net samples.* Average lygus populations in both treatments remained at or below 6 lygus per sample throughout the season (Figure 2a). These values were well below treatment thresholds: calculated thresholds during the critical period of squaring (mid-July to early August) were over 10 lygus per sample. When summed over the season (after omitting very early and very late sampling dates on which potential for lygus damage is minimum), neither total lygus nor lygus nymph numbers (Fig. 2b) were significantly different between BASIC and control fields.

Natural enemy (predator) populations were higher in BASIC treatment fields than control fields on over half of the sampling dates (Fig. 3a), a result similar to results from 1996 and 1997. When summed over the whole season, total natural enemies were significantly more abundant in BASIC than in control fields ( $p < 0.05$ , Kruskal-Wallis). As also was the case in the prior two years, the most common of these insects, bigeyed bugs (*Geocoris* spp.), drove this trend (Fig. 3b). Bigeyed bugs were significantly more abundant in BASIC than control fields when summed over the whole season. The second most common natural enemy, minute pirate bugs (*Orius tristicolor*), was more abundant in BASIC fields mid-season, but less abundant later in the season (Fig. 3c); total numbers through the season did not differ between treatments. Damsel bugs (*Nabis* spp.) were the third most common natural enemy, and were present in higher numbers consistently in the BASIC than the control fields (Fig. 3d). Summations over the season of damsel bug abundances were significantly higher in BASIC than control fields.

Although they have been released through the season in BASIC fields, lacewings abundances have been low in our samples (Fig. 3e), with values comparable between BASIC and control fields. Other natural enemies, including ladybird beetles, assassin bugs, and spiders, have been present in low numbers this year, and we have found no trends in their population abundances. Total juvenile predator (Figure 3f) were consistently more abundant in BASIC fields (and values were significantly higher when summed over the whole season), indicating that BASIC fields provide better conditions for *in-situ* buildup of natural enemy populations.

*Leaf samples.* Figure 4a shows the average mite rank in each treatment, and Figure 4b shows percent of leaves infested with mites. Percent mite infestations were higher during most of the season in BASIC than in control fields. Infestation levels in BASIC fields reached about fifty five percent, slightly above the suggested action threshold of fifty percent. Maximum average infestation in control fields was about twenty five percent. Average mite ranks in both

treatments remained below two, or less than ten mites per leaflet. Populations of western flower thrips, a mite predator which can also cause plant damage, were low in both treatments throughout the season, but were higher in the BASIC than in the control fields (Fig. 4c). Aphid infestation levels (Fig. 4d) remained low all season in both treatments. Total predator eggs, larvae, and nymphs in the leaf samples were higher in BASIC fields than control fields for all sampling dates (Fig. 4e).

*Effects of adjacent alfalfa plantings.* During the critical period of cotton squaring there were fewer lygus nymphs, and they appeared slightly later in the season, in fields adjacent to alfalfa compared to fields not adjacent to alfalfa (Figure 5a). Differences on a few of the sampling dates appeared to be significant, but we have not yet completed statistical analyses. There were no apparent differences in lygus adult abundances between these two treatments (Figure 5b). While bigeyed bugs were more abundant in fields adjacent to alfalfa (Figure 5c), total natural enemy numbers did not appear to differ (Figure 5d). We intend to do an additional analysis of single cotton fields, comparing sweep sample results from the two quadrants close to the adjacent alfalfa field with results from the two quadrants far from the alfalfa; these results will be presented in a supplement to this report.

#### *Cotton yield and quality*

Based on hand-harvest data, yields in 1997 and 1998 from BASIC fields were lower than yields from control fields. In 1997 hand-harvested yields were  $1.6 \pm 0.13$  bpa in BASIC fields and  $2.0 \pm 0.14$  bpa in conventional control fields. In 1998, hand-harvest yields were  $1.4 \pm 0.12$  bpa in BASIC fields compared to  $2.18 \pm 0.05$  bpa in control fields. Within BASIC, the organic fields yielded less than the non-organic ones in both years (1997:  $1.48 \pm 0.09$  bpa compared to  $2.07 \pm 0.15$  bpa; 1998:  $1.3 \pm 0.16$  bpa compared to  $1.65 \pm 0.06$  bpa).

Gin records showed the same yield trends in both years. Gin-based yields in 1997 and 1998 from BASIC fields were lower than yields from control fields (BASIC 2.1 [1997] and 1.4 [1998] bales per acre; control 2.9 [1997] and 2.3 [1998] bales per acre). This yield difference was mainly due to organic yields: in both years, organic yields were significantly lower than conventional control yields, but non-organic yields were not (Figures 6a and 7a) (in these figures, the combined BASIC values were not included in the statistical analyses).

In 1997, complete gin records (fiber length, strength, and micronaire; leaf content; and grade) were available from only four of the control growers. Using these records, fiber length, strength and micronaire (width) did not differ markedly between treatments (Figure 6b). However, conventional fiber strength and micronaire appeared slightly lower in conventional than that of the organic BASIC fields. Leaf content in 1997 (Figure 6c) was somewhat higher in organic BASIC than in conventional fields. There were more low-grade bales in the organic and non-organic BASIC fields than in the control fields in 1997 (Figure 6d), but these differences did not appear significant.

In 1998, cotton fibers were significantly longer in the control fields than the organic BASIC ones, but fiber length in non-organic BASIC fields did not differ from either of the other treatments (Figure 7b). Fiber strength did not differ between treatments. Micronaire (fiber width) was significantly greater in both organic and non-organic BASIC fields than in control fields, but values in all treatments were within the optimum micronaire range. Leaf content in 1998 did not differ significantly between BASIC and control fields, but was significantly higher in organic BASIC than non-organic BASIC fields (Figure 7c). In 1998 there were significantly more bales in the low grade range, and significantly fewer bales in the best grade range, in organic BASIC fields than in the control fields (Figure 7d).

#### *Production costs*

Using cost of production data from 1997, we found that operational costs per bale were almost 50% higher for BASIC growers who were following organic production methods than for control growers (Table 1). Operational costs of production for non-organic BASIC growers were about the same as those for control growers. Increased costs for organic growers were mainly due to weeding costs. Weeding is done by contract weeding crews, and is represented in the cultural “Custom/Rentals” category in Table 1. Weeding costs were three times higher in organic BASIC fields than in conventional controls. Materials costs in organic and non-organic BASIC fields were 40% and 55%, respectively, of those in conventional fields.

#### d. Discussion

##### *Plant development*

Most in-season measures of plant development did not differ between treatments, indicating that organic and non-organic BASIC production methods did not cause undue stress on plants nor result in increased square or boll square loss.

Organic fields were planted at a higher density in 1998 than in prior years in which we have studied organic cotton. Although 1998 organic densities were still lower than those of conventional control fields, the differences we have seen in prior years in boll retention patterns between organic and conventional plants were much less prominent this year. In prior years organic BASIC fields have had more outer position (second, third, and greater) bolls, and more bolls per plant, than control fields. In 1998, conventional control plants had slightly more first position bolls, and slightly fewer “third +” position bolls than did organic BASIC plants, but the total number of open bolls per plant did not differ between treatments. This reduction in treatment difference is at least partly due to immaturity in the organic BASIC fields: organic fields had more green bolls left at harvest than did control fields. An effective harvest preparatory material may have helped mature these bolls, but there is as yet no such material for organic fields.

### *Insect populations*

Both mite numbers and percent of leaves infested with mites were substantially higher in BASIC than in control fields for the majority of the season, but lygus numbers - most importantly, lygus nymphs - were not more abundant in BASIC fields. Generalist natural enemies were far more abundant in BASIC fields than in control fields; this treatment difference was first apparent after mite populations started to increase in BASIC fields, and may have been partly the result of the presence of this common prey. The abundance of generalist predators in BASIC fields may have likewise been partly responsible for holding lygus populations in check through consumption of eggs and/or nymphs.

Results from our alfalfa study encourage us to believe that alfalfa may be useful in this region to help keep lygus populations under control in cotton fields. Lower numbers of lygus nymphs are presumably the result of lygus adults preferring alfalfa over cotton for oviposition when given the choice, allowing alfalfa to act as a trap crop for lygus nymphs. Alfalfa fields were not managed in this study to optimize this function; if they were - for example, using strip cutting - the trends we measured in this study could become more pronounced. Management would require cooperation between multiple growers, since many of the adjacent alfalfa fields in this study were farmed by different growers.

### *Cotton yields and quality*

In 1997 and 1998 our ability to predict average cotton yields using hand-harvested samples improved: in 1997, our estimates were on average 12% lower than gin yields in BASIC fields, and 18% lower than gin yields in control fields. In 1998, our estimates matched gin yields in BASIC fields, and were on average 5.5% lower than gin yields in control fields. Within individual fields, however, our estimates were not as consistent or good, differing from gin records by anywhere between 3 and 20%. We would like to improve this accuracy; gin records are not always available by field from each grower, making hand-harvest yield estimates crucial for precise and timely estimates of treatment effects.

Regardless of method of yield determination, organic BASIC fields yielded significantly less cotton in 1997 and 1998 than did control fields. This yield difference was more pronounced than we have seen in previous years. However, organic BASIC cotton quality has improved relative to control quality in terms of color grades and leaf material. Yield differences may have been due to one or more of the following four factors: (1) Pest pressure. In several of the organic BASIC fields percent mite infestation levels exceeded the 50% level recommended for treatment. Control mite levels remained below 40%. (2) Weed competition. Although we did not formally assess weed population sizes, several of the organic BASIC fields were notably weedier than their conventional controls throughout much of the season. (3) Plant maturity at harvest. As noted above, organic BASIC plants did not yield to their full potential, since they had several more green bolls at harvest than did control or non-organic BASIC plants. (4) Fertility. We do not know the current fertility situation in organic BASIC fields.

Yields in 1998 were lower than normal in all treatments due to effects from El Niño. A comparison of the relative quality of organic BASIC and control cotton indicates that poor years may hurt organic more than control cotton. 1998 was the first year in which we have recorded differences in staple length or micronaire in organic cotton as compared to controls, and organic lint produced more stained bales than did controls. Leaf trash ranking did not differ between organic BASIC and control bales, but that was because control bales had higher than usual trash levels, not because organic BASIC bales had reduced their trash levels.

#### *Production costs*

As has been the case for each of our three years of data so far, BASIC materials costs were lower and custom costs (mainly weeding) were higher than in the control systems. The decrease in materials costs in BASIC fields reflects fewer pesticide and defoliant applications; reductions in these costs did not make up for the increased custom costs incurred by organic BASIC growers, who had higher overall production costs than did control growers. Non-organic BASIC growers, on the other hand, were able to decrease their total operational costs of production below those of control growers. Since all BASIC yields were below conventional control yields, total costs per bale were higher for BASIC than control growers. At its current level, BASIC cotton requires a separate market to be economically viable for growers. Alternative weed control methods are one of the most pressing needs for the BASIC system from an economic standpoint.

#### e. Summary and Conclusions

The BASIC Pest Management Innovators Work Group in cotton tests and disseminates innovative ideas in cotton chemical use reduction through an organized outreach program made up of cotton farmers, pest control advisors, agronomists, and U.C. Farm Advisors and researchers. Growers using this approach (“BASIC growers”) were able to reduce their insecticide and miticide use by 90% in one year of study.

In 1998, our scientific investigation was focused on biologically based management of arthropod pests using a multi-component approach including intensive monitoring and natural enemy releases. We found more mites in BASIC than in control fields. Lygus numbers were slightly higher in BASIC than control fields, but values summed over the critical period of the season were not significantly different between the treatments. Aphid numbers were similar between the two treatments. Predatory insects were more abundant in BASIC fields throughout the season, mostly due to bigeyed bugs.

In an auxiliary experiment, we found that cotton fields adjacent to alfalfa fields harbored fewer lygus nymphs during the critical period of cotton squaring than did cotton fields not adjacent to alfalfa fields. Presumably, when given a choice, lygus prefer alfalfa to cotton for oviposition, thus keeping lygus nymphs out of the cotton fields. This result encourages us to think that management of alfalfa fields to optimize this trap crop function could provide even stronger positive results. Management could include strip cutting and irrigating alfalfa to leave a constant lygus habitat, or spraying alfalfa fields with a lygicide immediately prior to cutting.

We did not find increases in square shedding (caused by lygus bugs) in BASIC fields. However, BASIC growers had lower yields in 1997 and in 1998 than did control growers (BASIC 2.1 [1997] and 1.4 [1998] bales per acre; control 2.9 [1997] and 2.3 [1998] bales per acre). Using cost of production data from 1997, we found that operational costs per bale were almost 50% higher for BASIC growers who were following organic production methods than for control growers. Operational costs of production for non-organic BASIC growers were about the same as those for control growers.

Our results point to the need for more research in two areas in particular: (1) economical and effective non-chemical weed control methods, and (2) effective crop preparation materials and methods which do not involve synthetic chemicals. In addition, there is a need for further research to optimize effectiveness of alfalfa or other trap crops in controlling lygus and other cotton pests. In the current and coming years of this project we will incorporate alternative weeding studies into our program and expand our results to more growers. We will also continue work on alfalfa trap cropping systems and other alternative pest control methodologies.

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# Appendix A

## Figures and tables

Figure 1a. 1998 BASIC  
plant heights

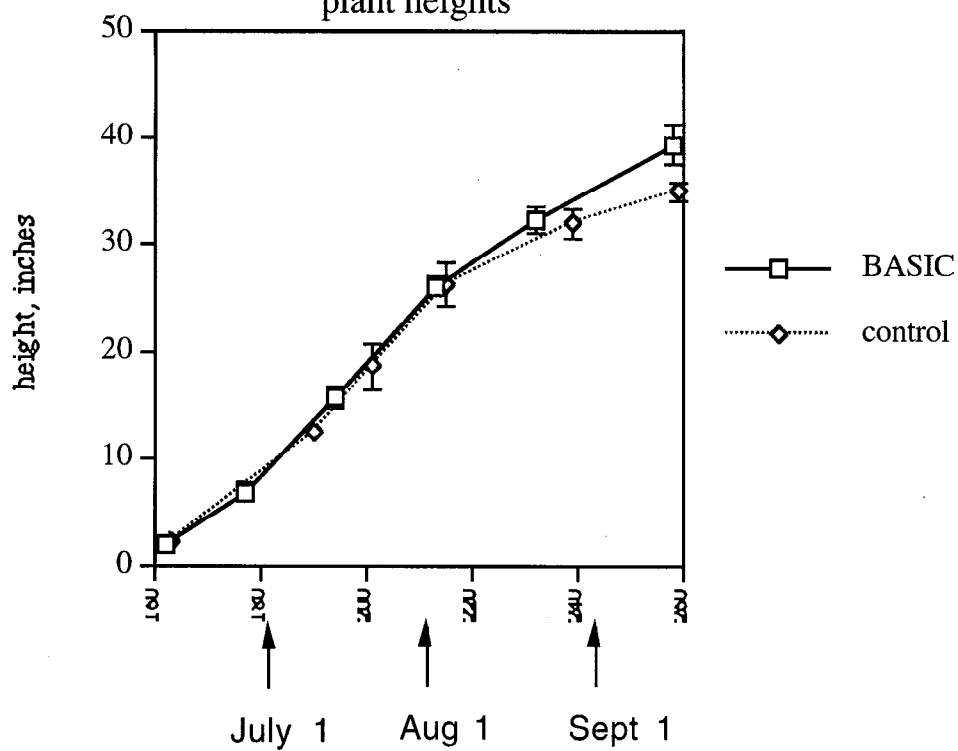


Figure 1b. 1998 BASIC  
vegetative nodes

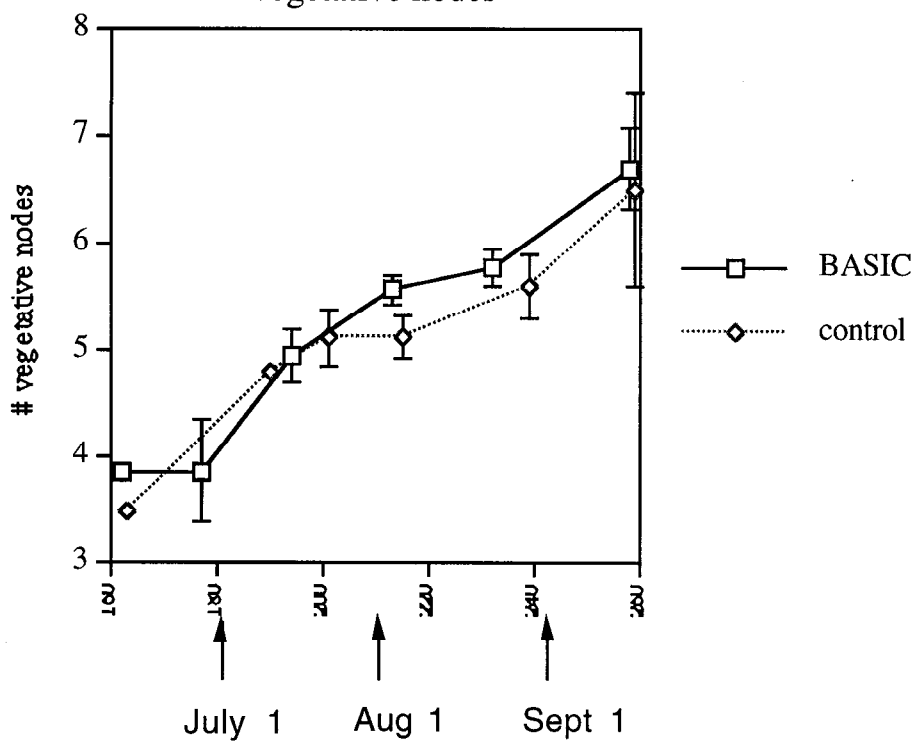


Figure 1c. 1998 BASIC  
nodes above white flower (NAWF)

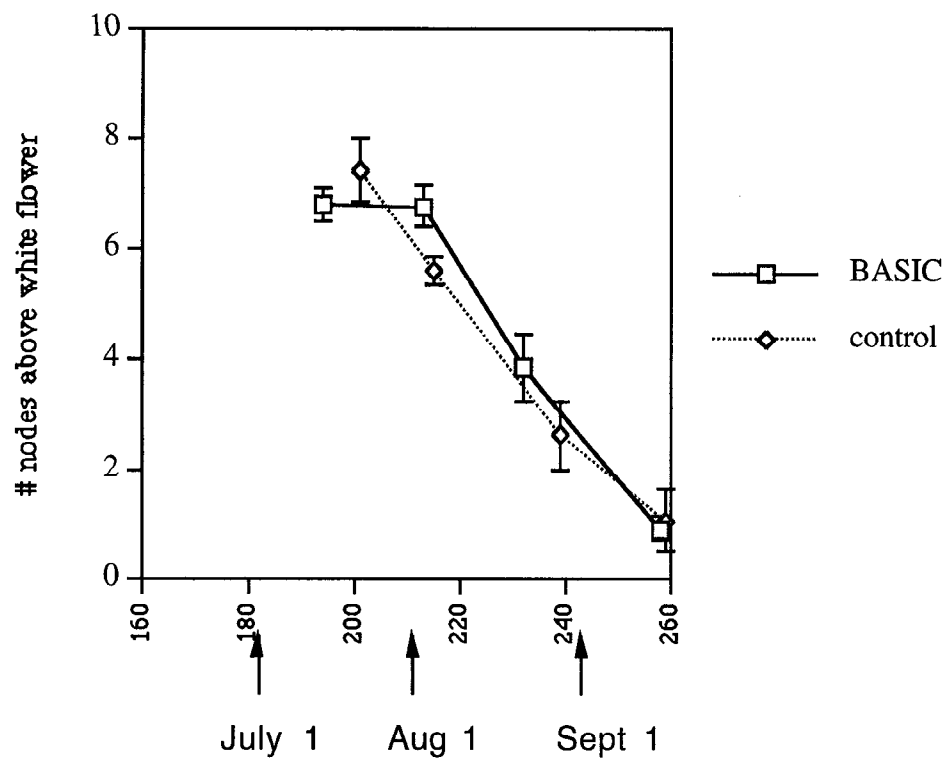


Figure 1d. 1998 BASIC  
retention of top 5 positions

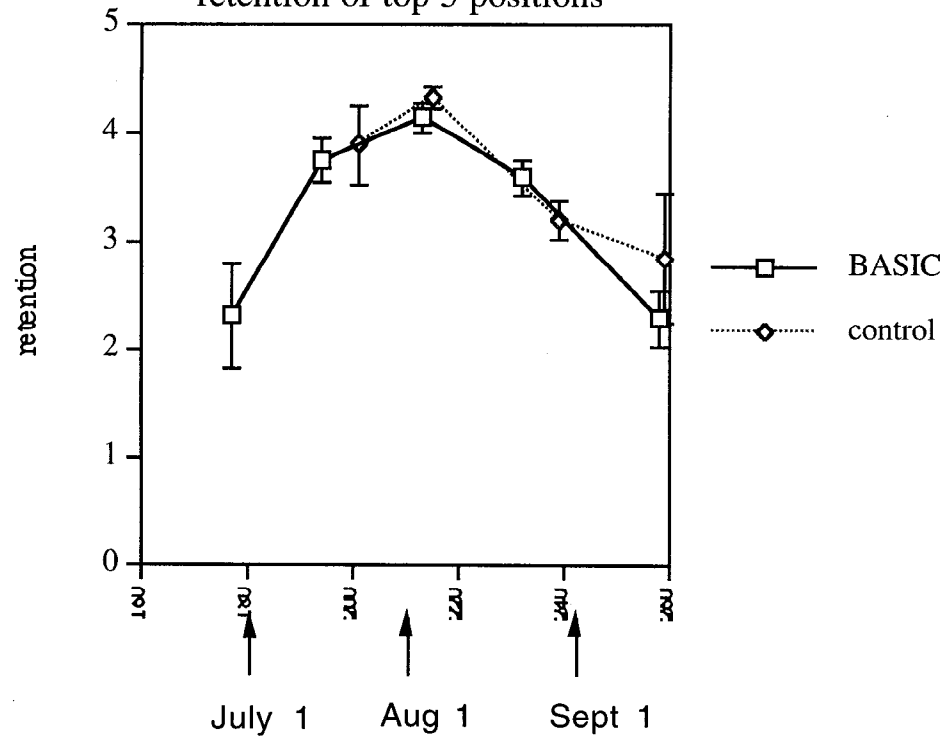


Figure 1e. 1998 BASIC  
retention of bottom 5 positions

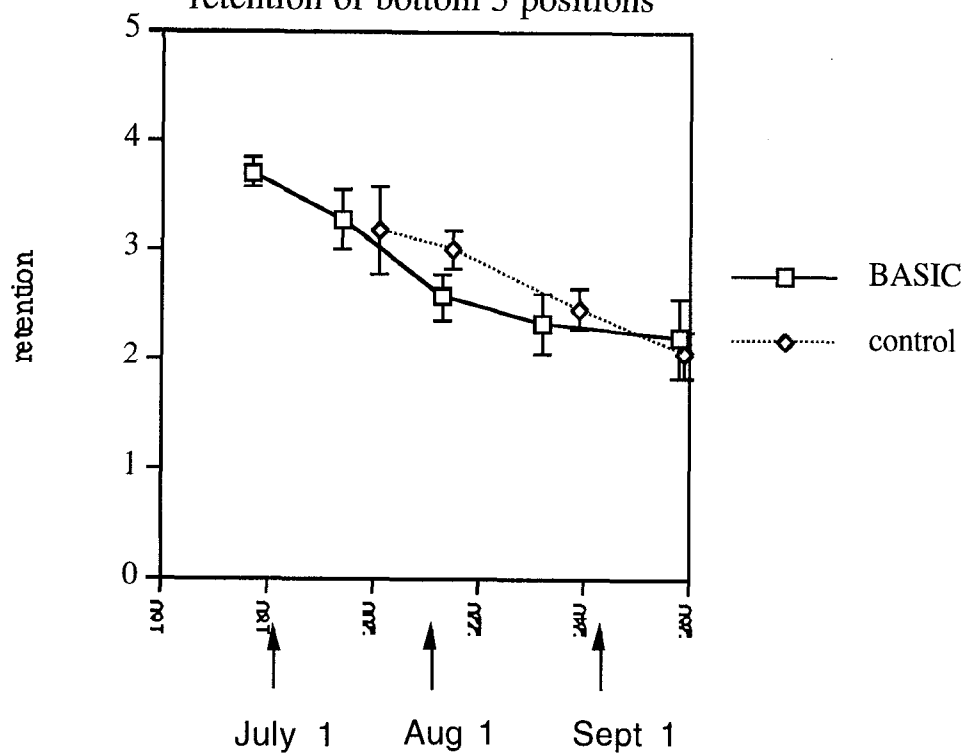


Figure 1f. 1998 BASIC  
total nodes

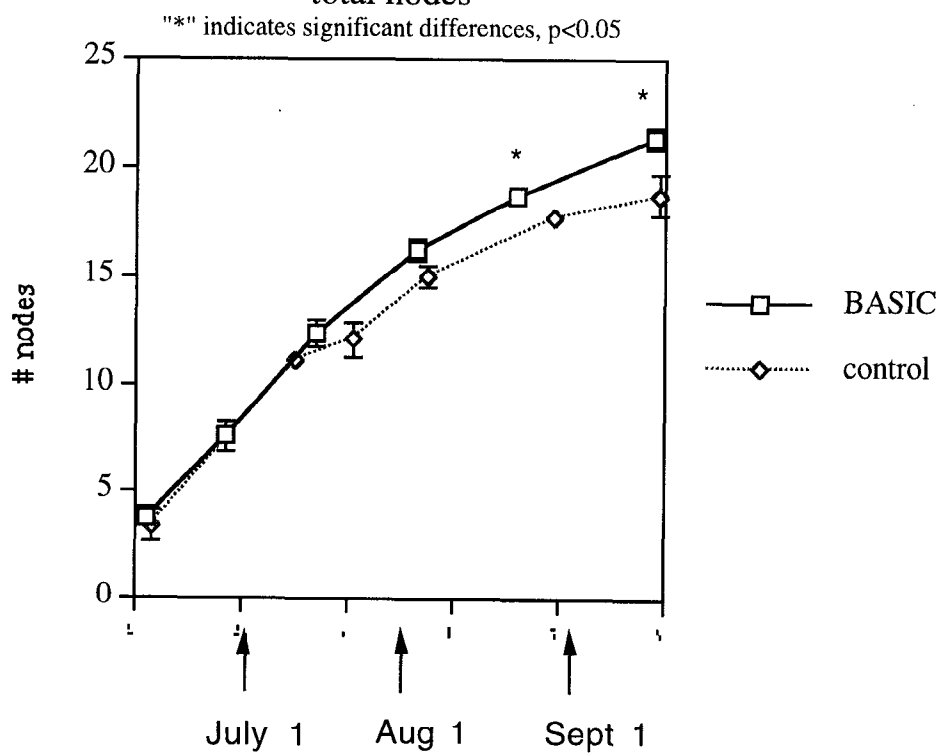


Figure 1g. 1998 BASIC  
fruiting branches

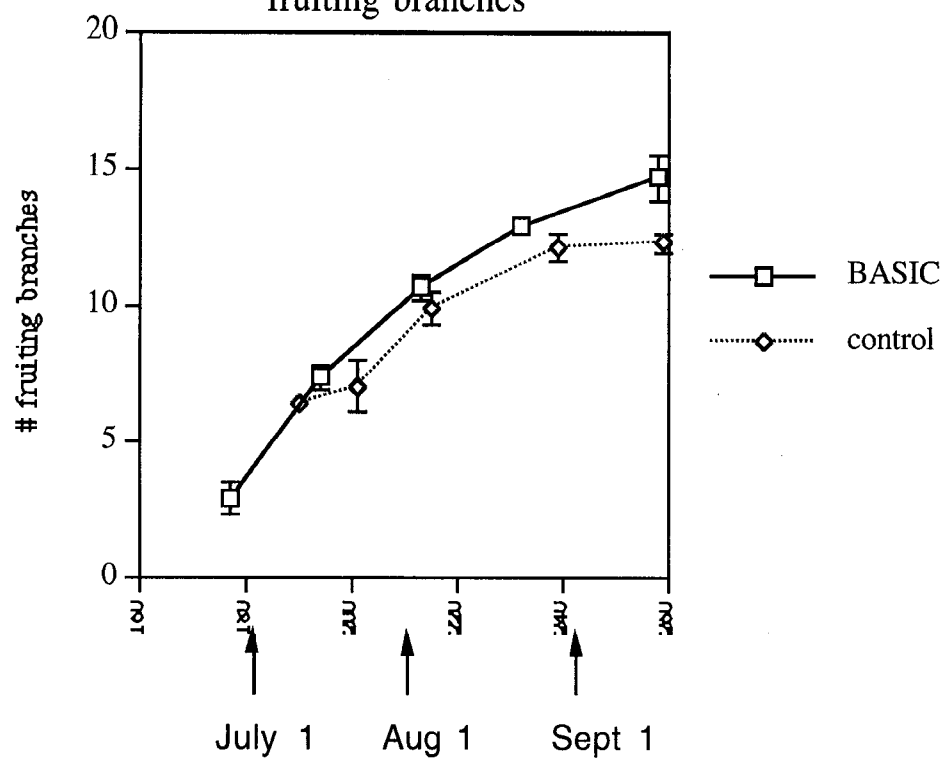


Figure 1h. 1998 BASIC final plant maps  
Plant height (inches) and number of nodes

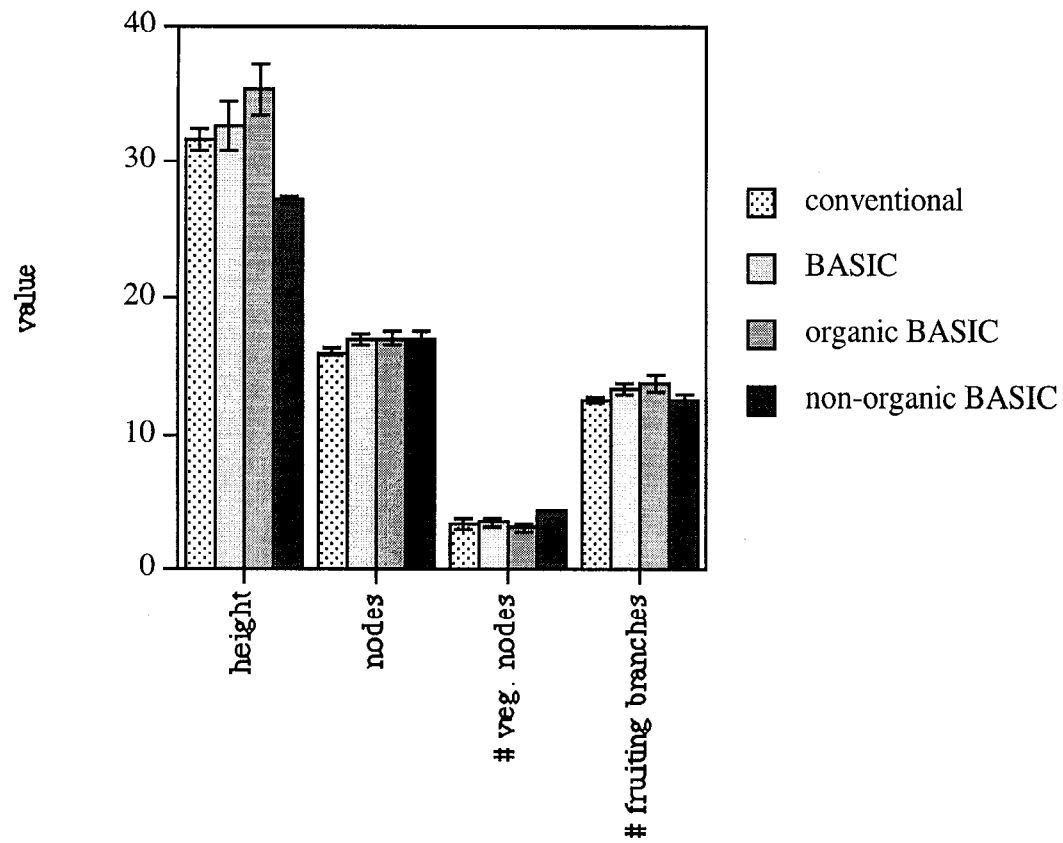


Figure 1j. 1998 BASIC final plant maps  
Number of open and green bolls per plant

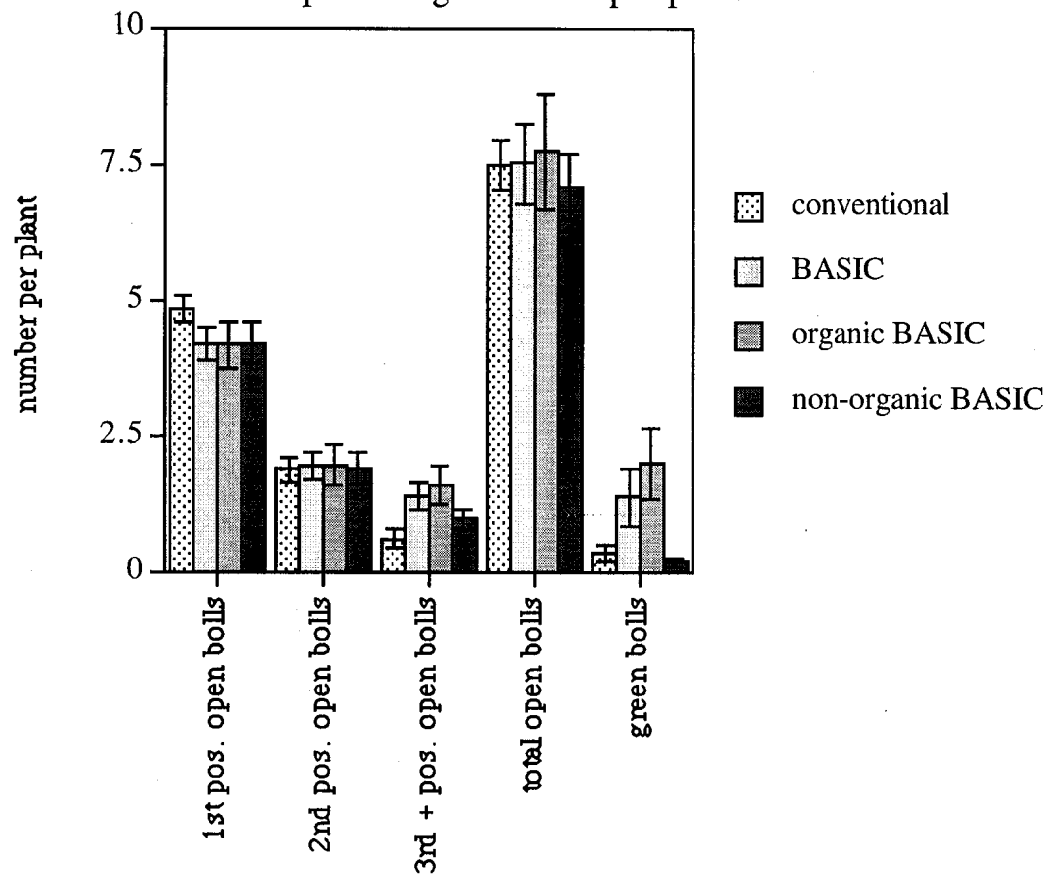


Figure 2a. 1998 BASIC  
Total lygus

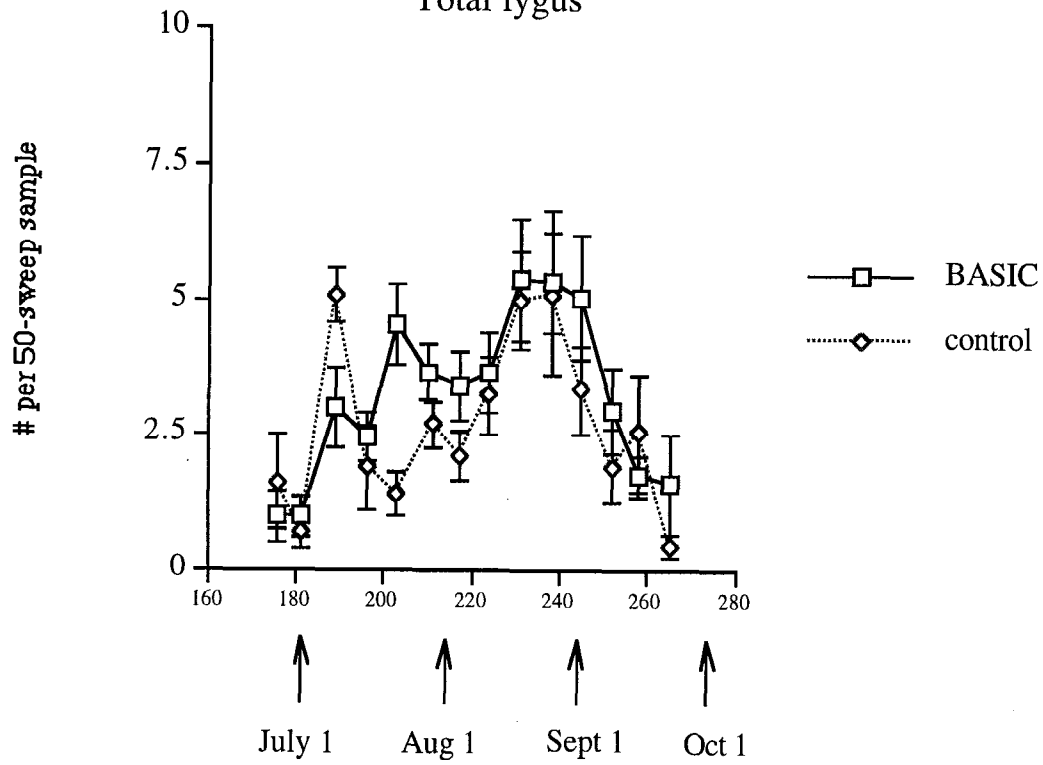


Figure 2b. 1998 BASIC  
Lygus nymphs

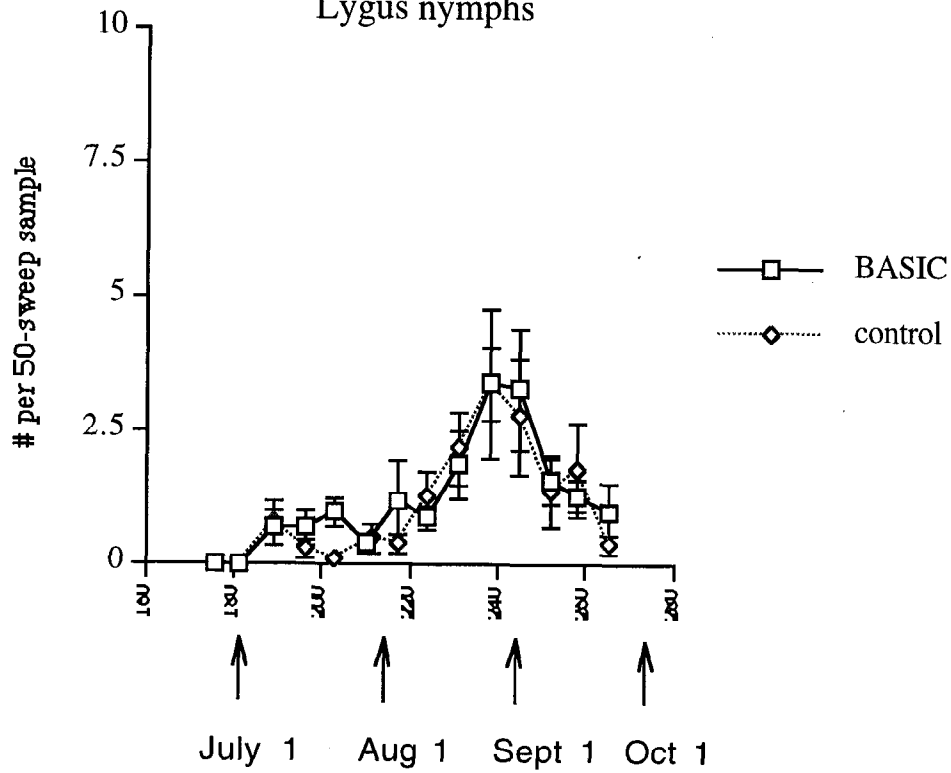


Figure 3a. 1998 BASIC  
Total generalist natural enemies

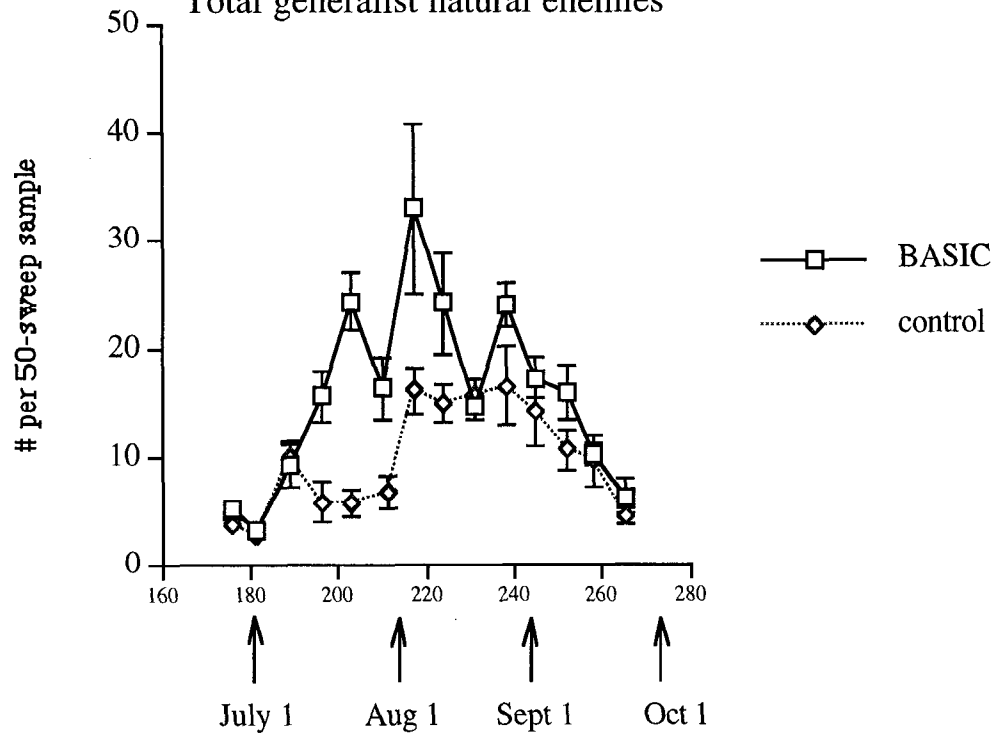


Figure 3b. 1998 BASIC  
Big-eyed bugs

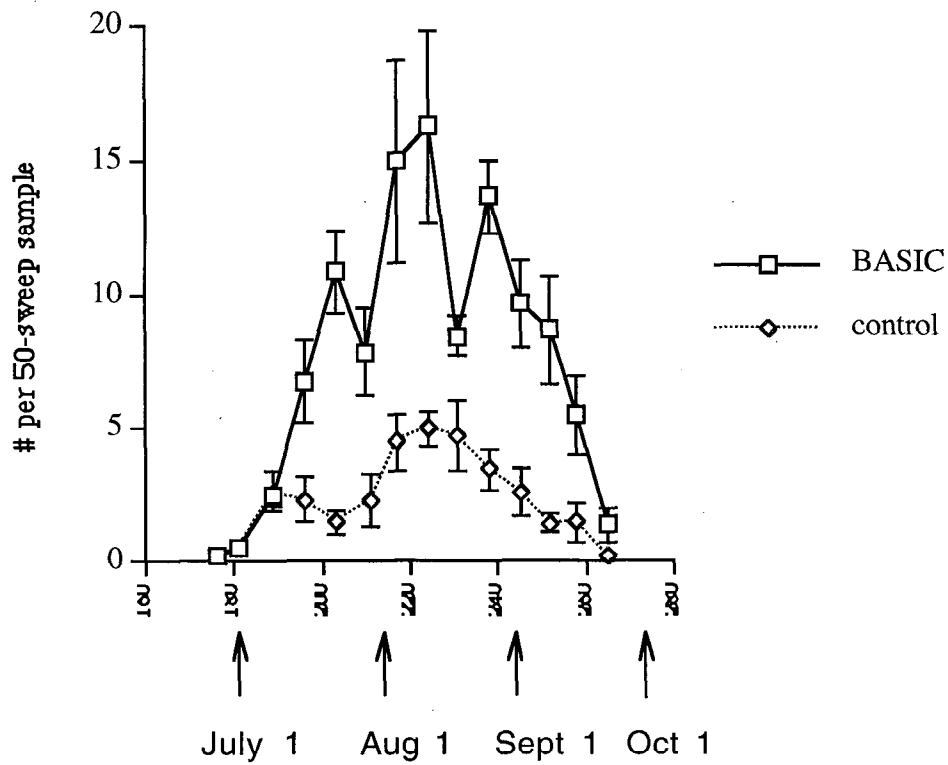


Figure 3c. 1998 BASIC  
Minute pirate bugs

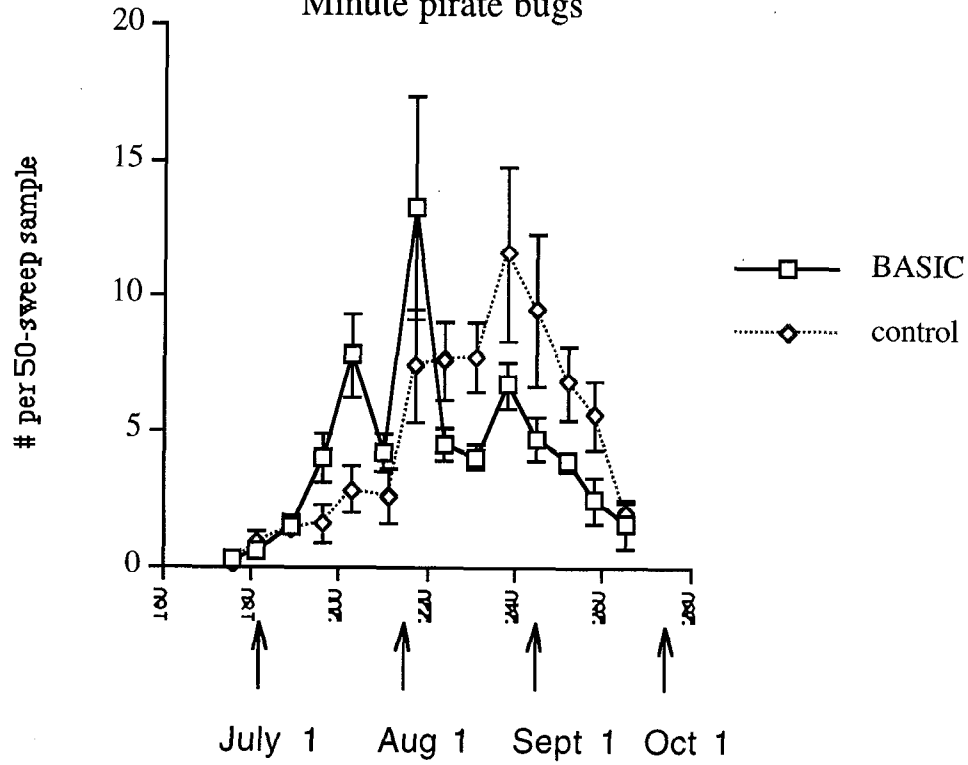


Figure 3d. 1998 BASIC  
Damsel bugs (nabids)

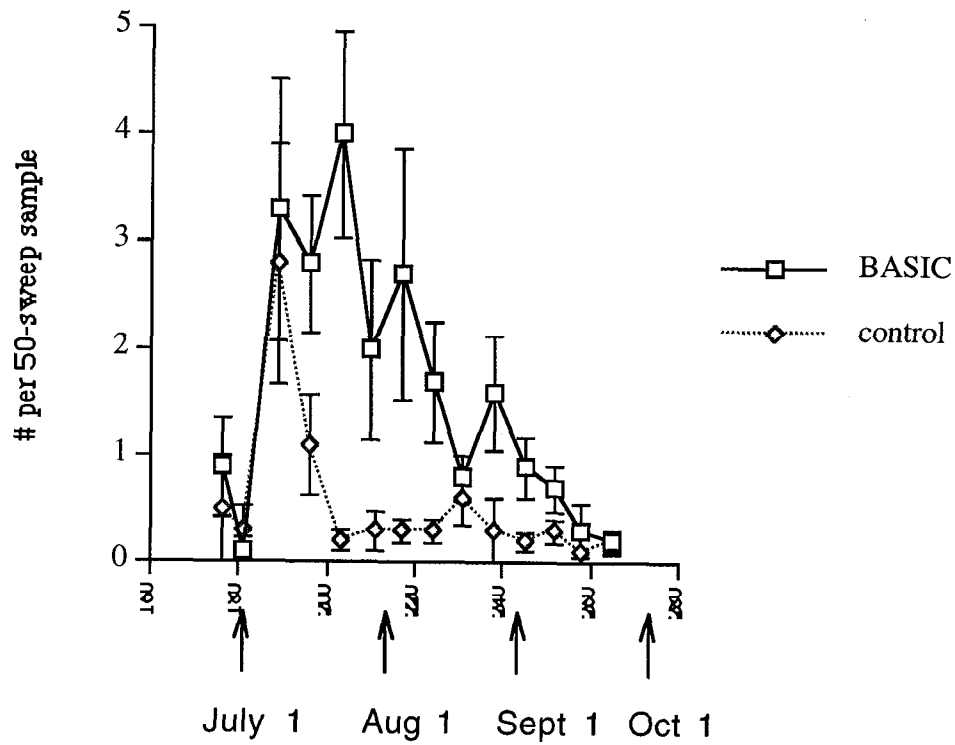


Figure 3e. 1998 BASIC  
Lacewings

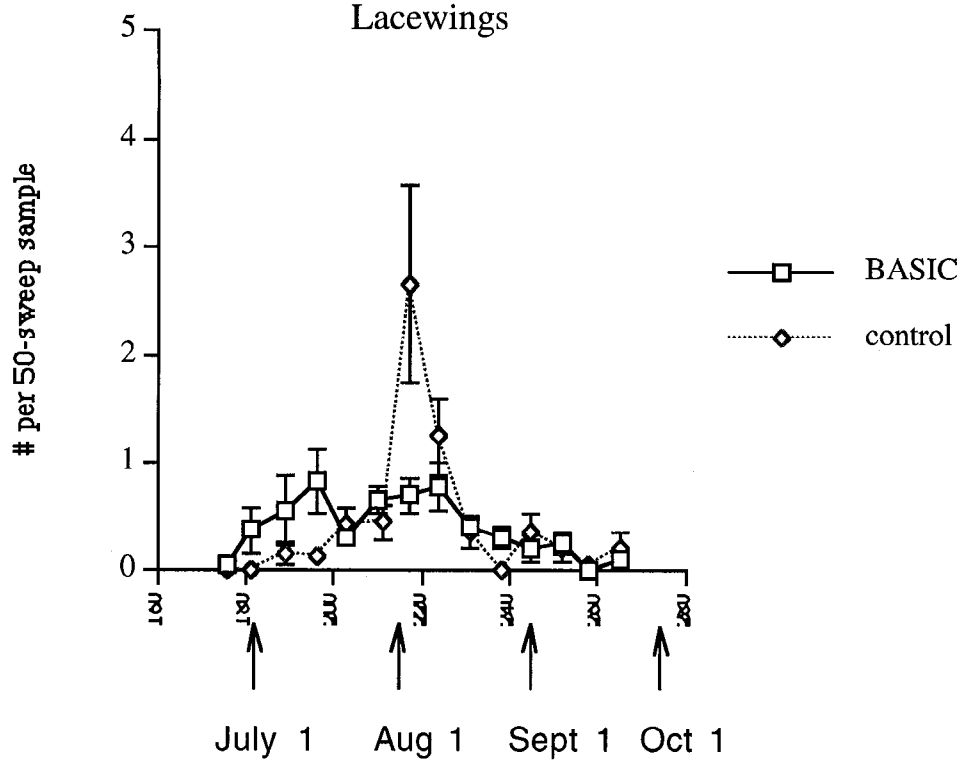


Figure 3f. 1998 BASIC  
Juvenile natural enemies

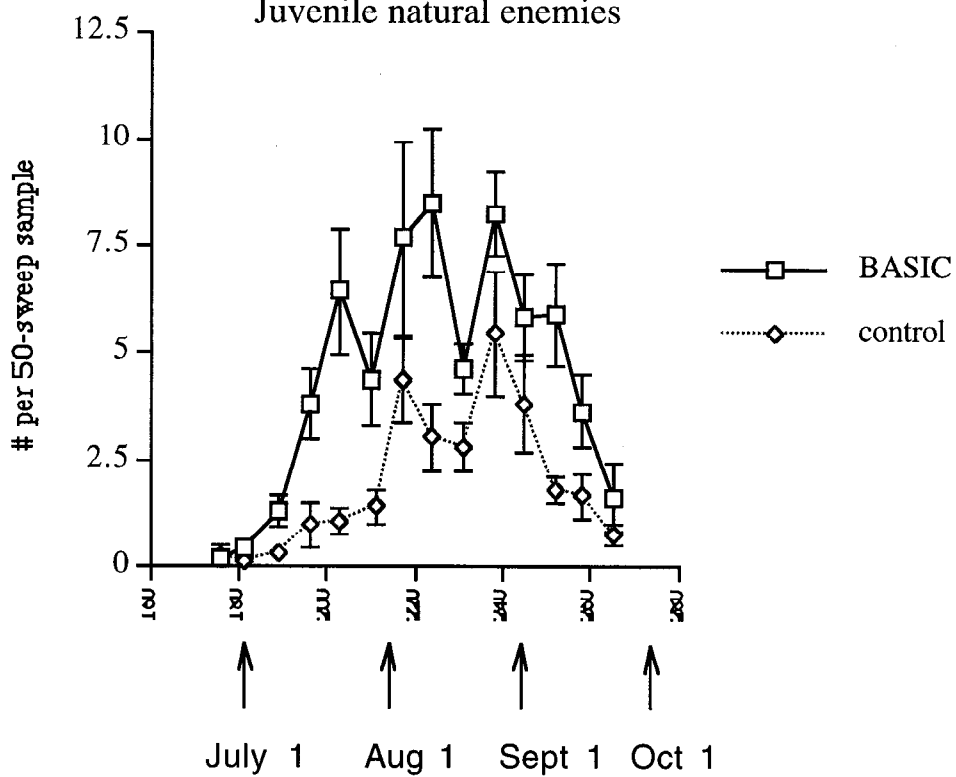


Figure 4a. 1998 BASIC  
Mite rank

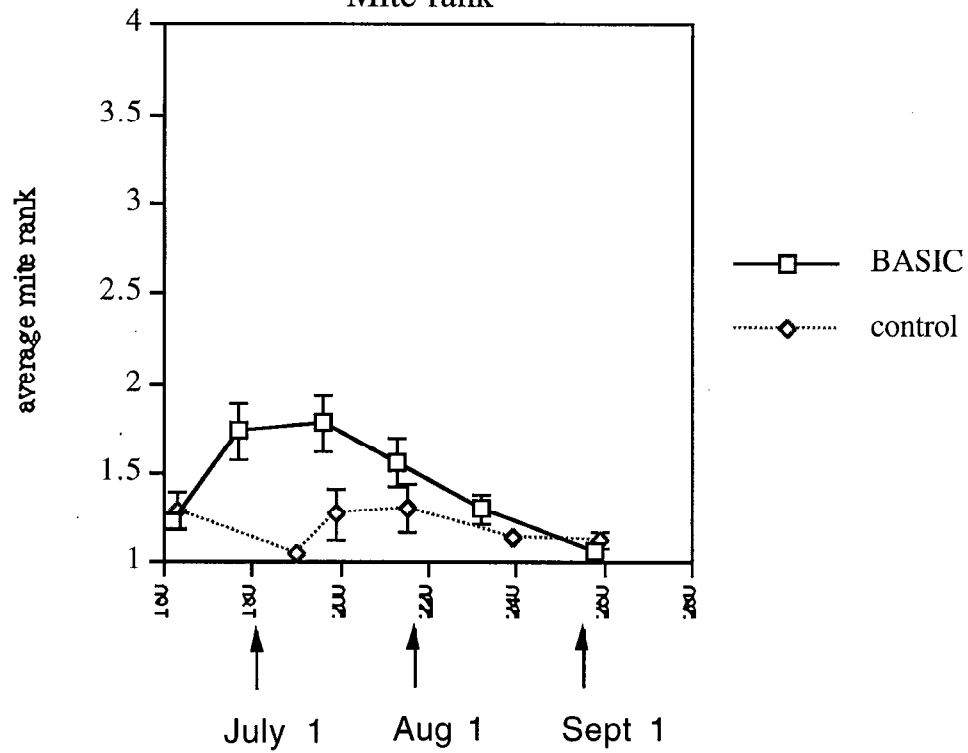


Figure 4b. 1998 BASIC  
Percent mite infestation

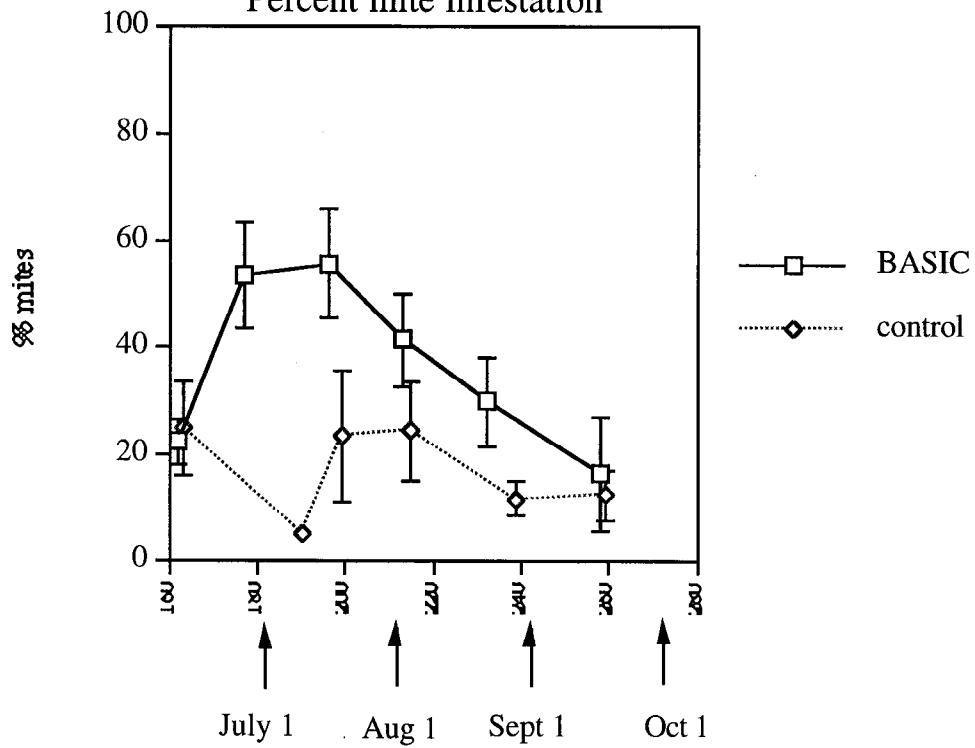


Figure 4c. 1998 BASIC

Thrips presence

Range of possible values is 1 (no thrips) to 2 (thrips on all leaves)

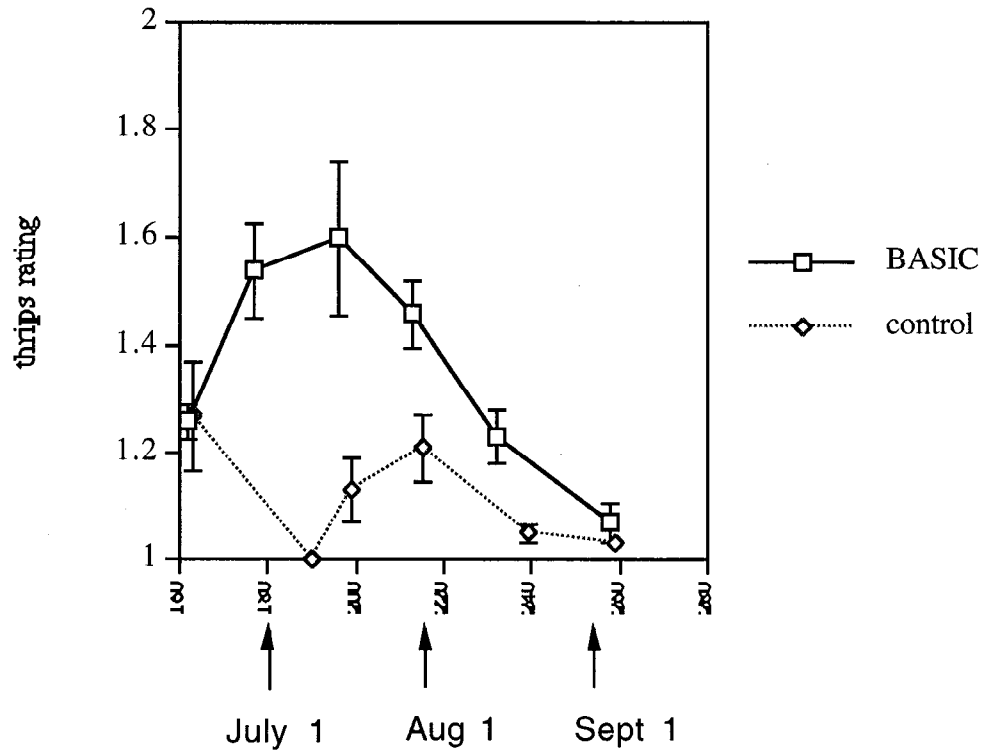


Figure 4d. 1998 BASIC  
Aphid Rank

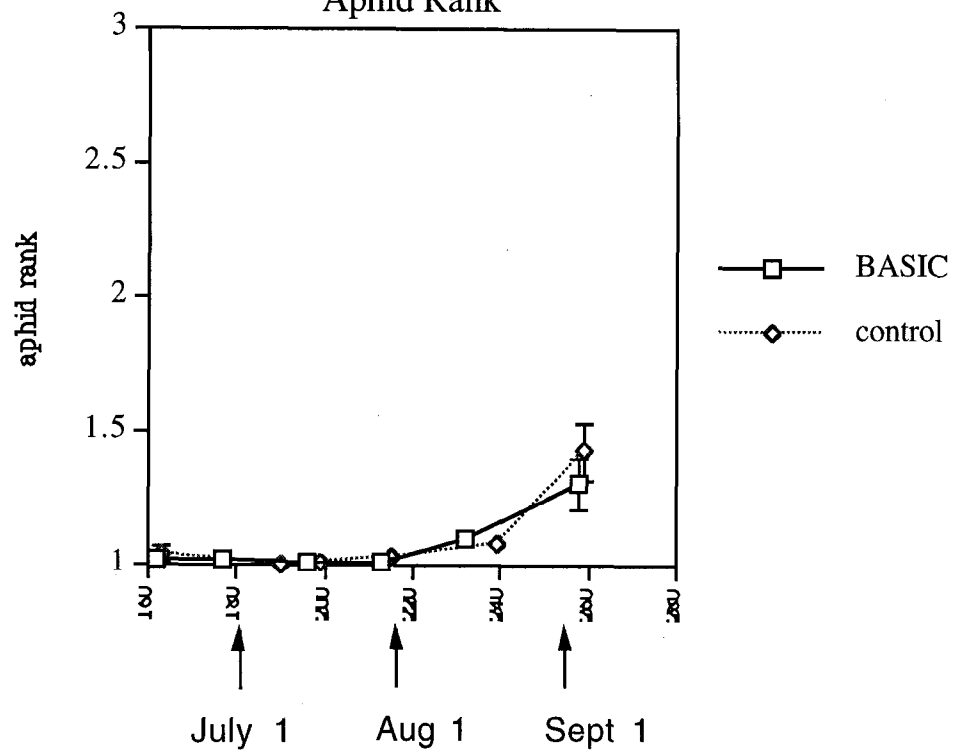


Figure 4e. 1998 BASIC  
Total Predators on Leaves

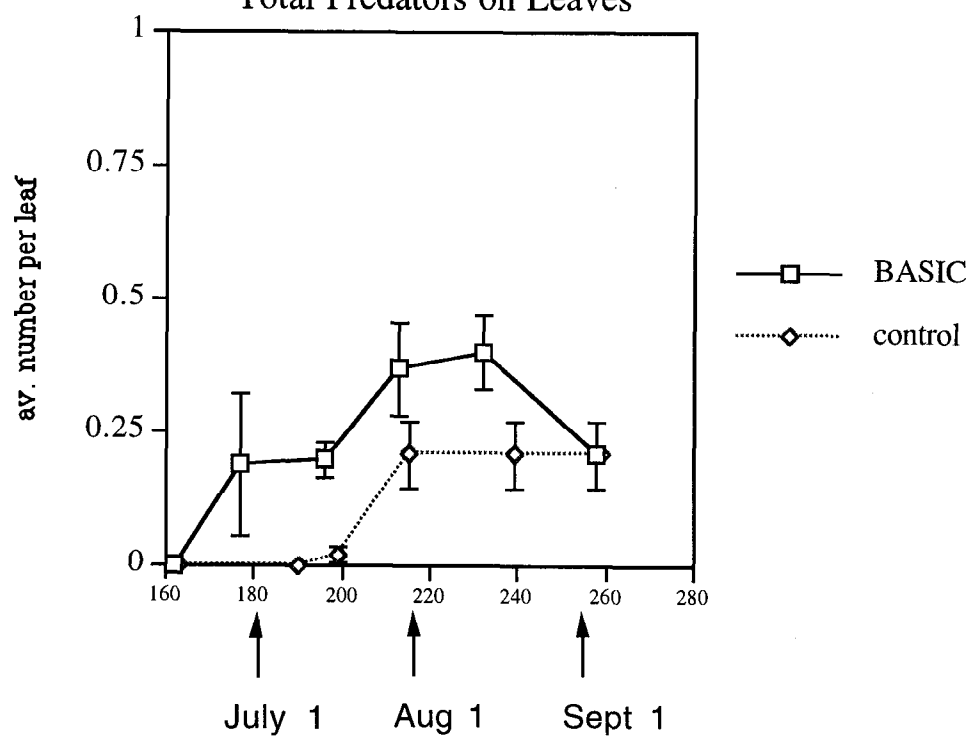


Figure 5a. 1998 BASIC  
Lygus nymphs in fields adjacent to alfalfa  
vs. not adjacent to alfalfa

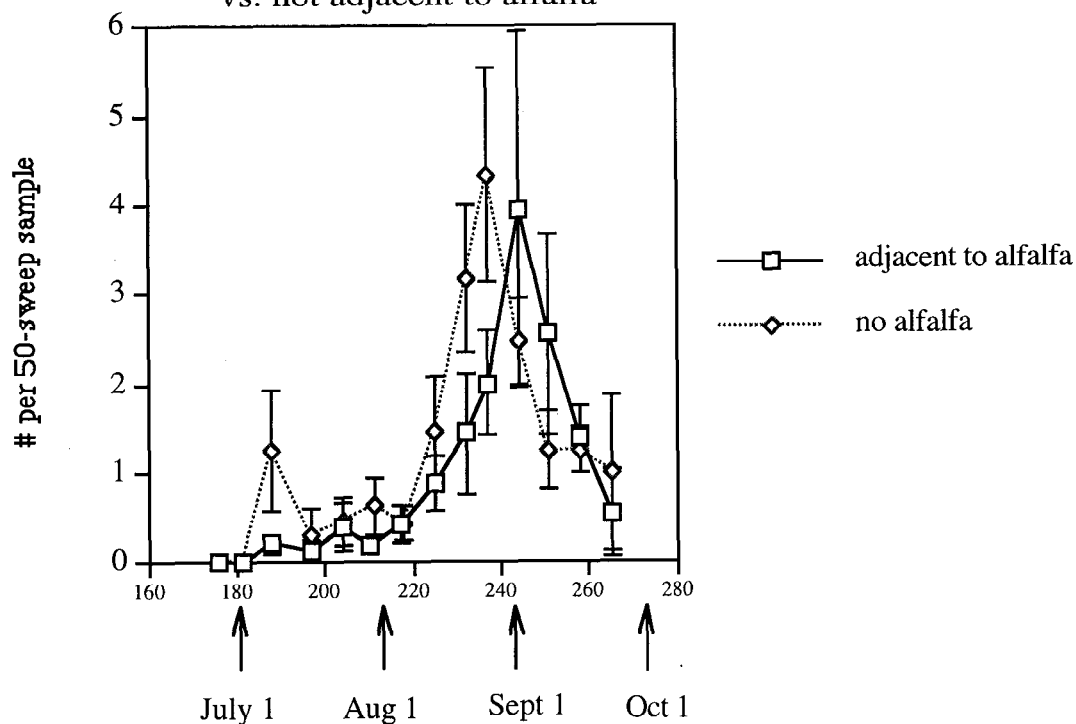


Figure 5b. 1998 BASIC  
Lygus adults in fields adjacent to alfalfa  
vs. not adjacent to alfalfa

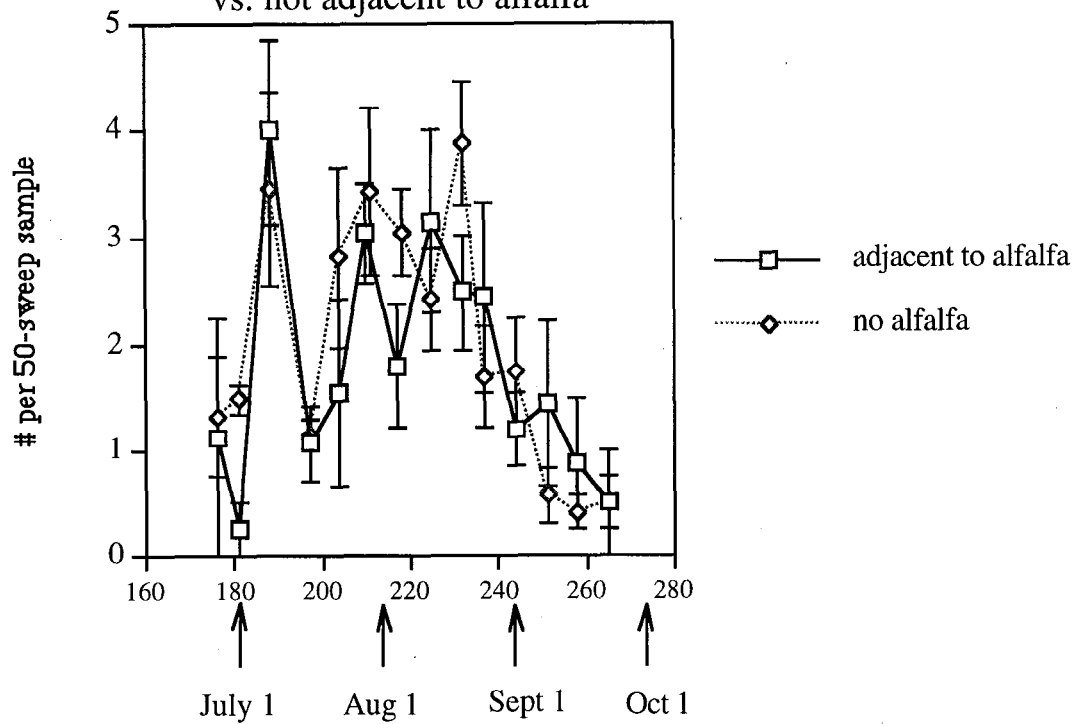


Figure 5c. 1998 BASIC  
Total bigeyed bugs in fields adjacent to alfalfa  
vs. not adjacent to alfalfa

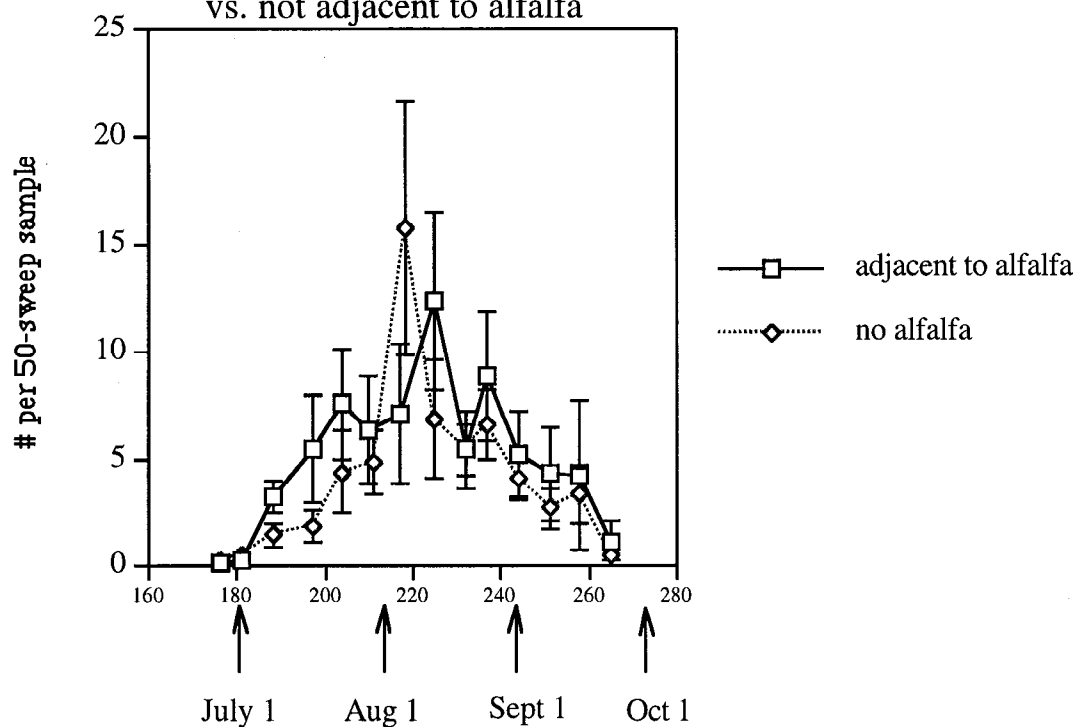


Figure 5d. 1998 BASIC  
Total natural enemies in fields adjacent to alfalfa  
vs. not adjacent to alfalfa

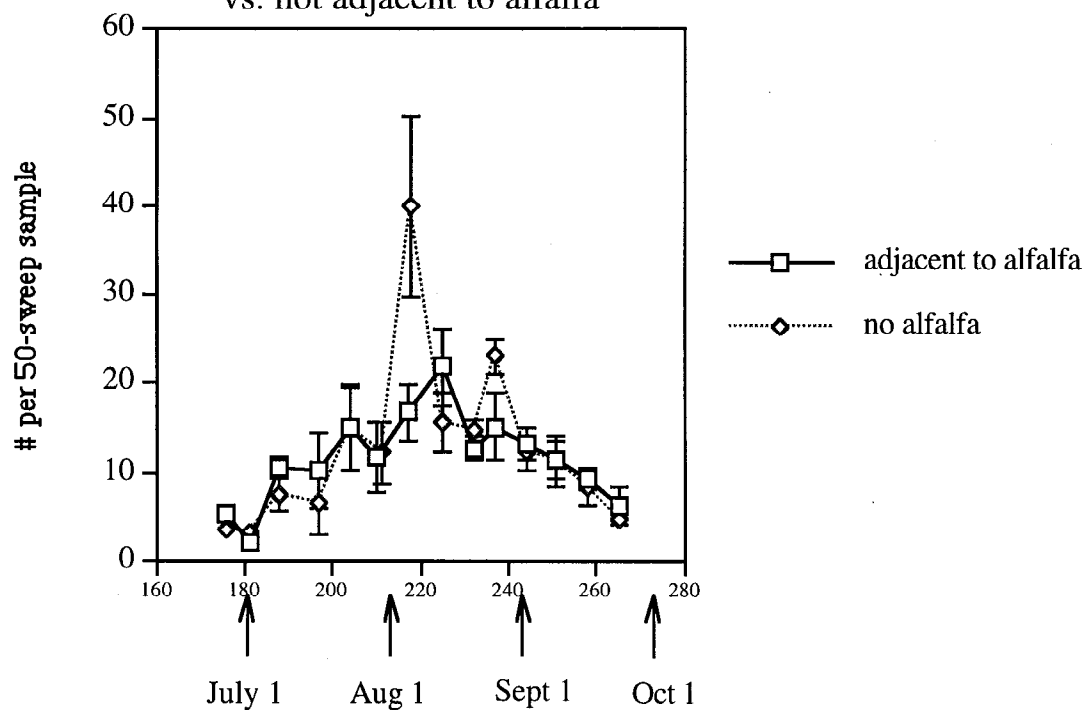


Figure 6a. 1997 BASIC  
yields from gin records  
different letters indicate significant differences ( $p < 0.05$ )

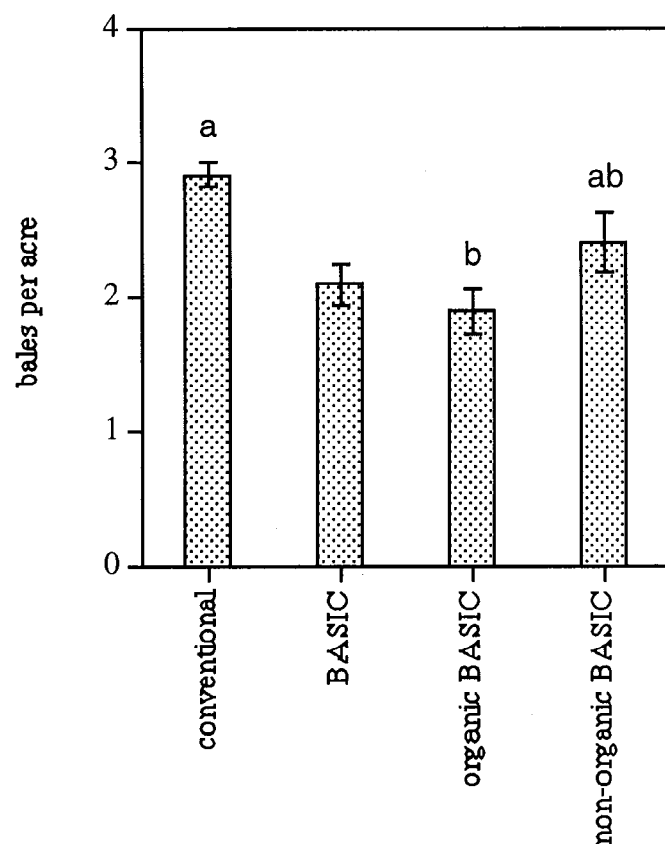


Figure 6b. 1997 BASIC fiber quality

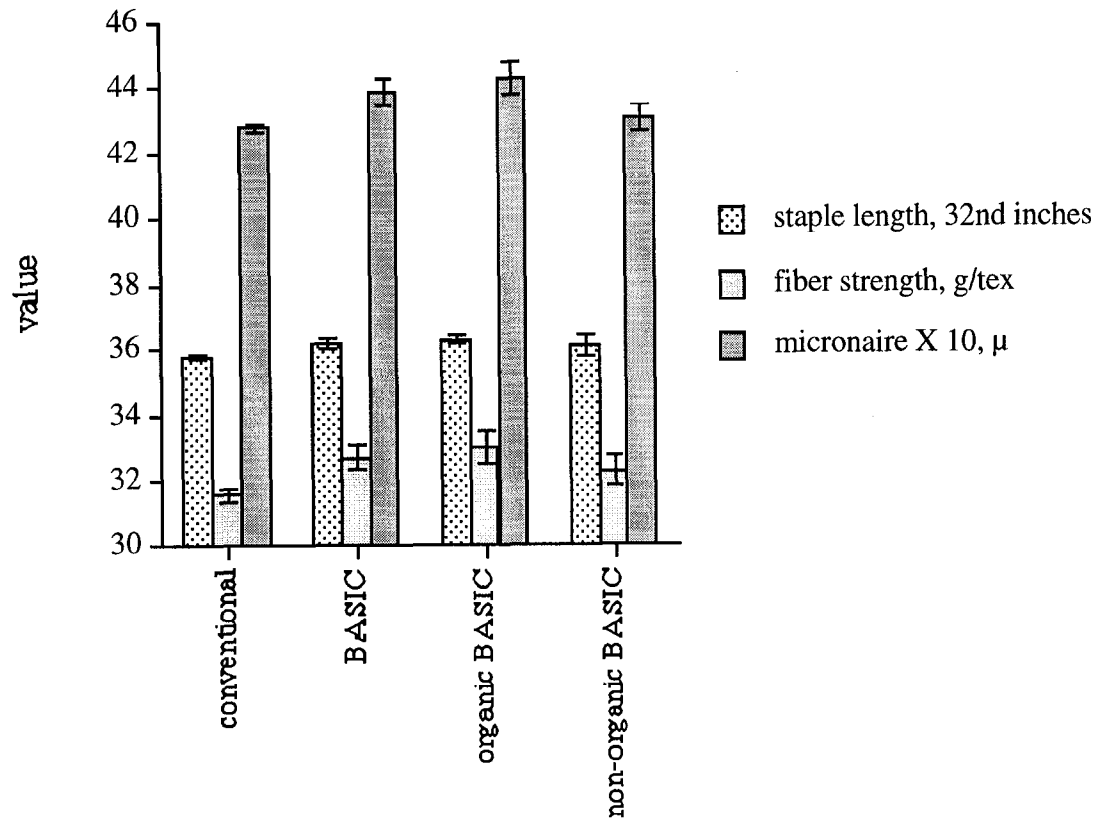


Figure 6c. 1997 BASIC  
leaf material in cotton bales

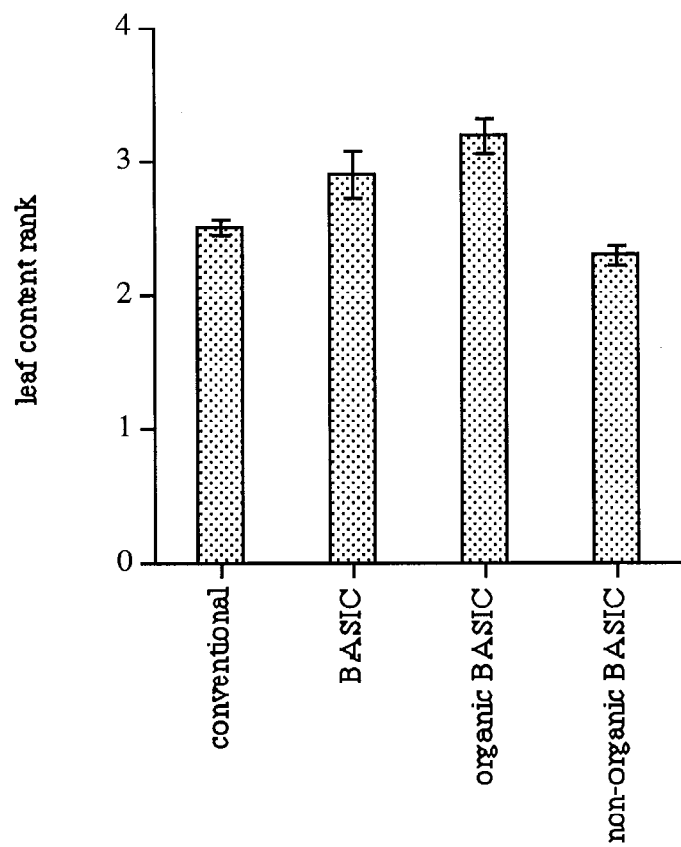


Figure 6d. 1997 BASIC cotton grades  
Percent of bales in different grade ranges

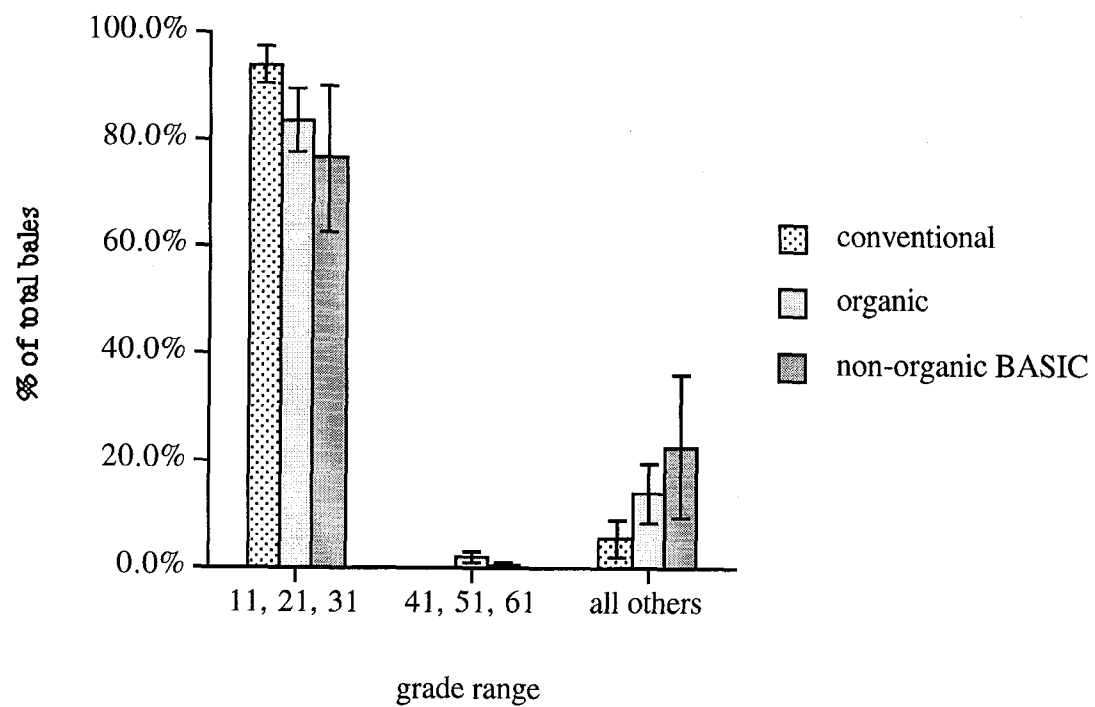


Figure 7a. 1998 BASIC  
yields (bales per acre) from gin records  
different letters indicate significant differences ( $p < 0.05$ )

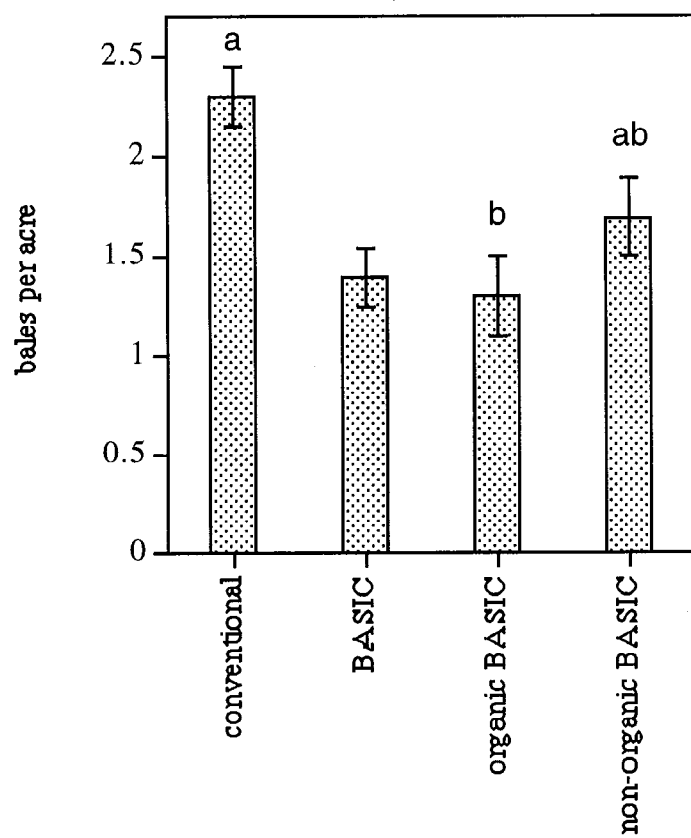


Figure 7b. 1998 BASIC fiber quality

bars with different letters or numbers are significantly different from other treatments ( $p < 0.05$ ).

Only the subcomponent BASIC types were tested for significance, with the exception of fiber strength. Fiber strength differences were significant between conventional and total BASIC treatments ( $p < 0.05$ , Kruskal-Wallis).

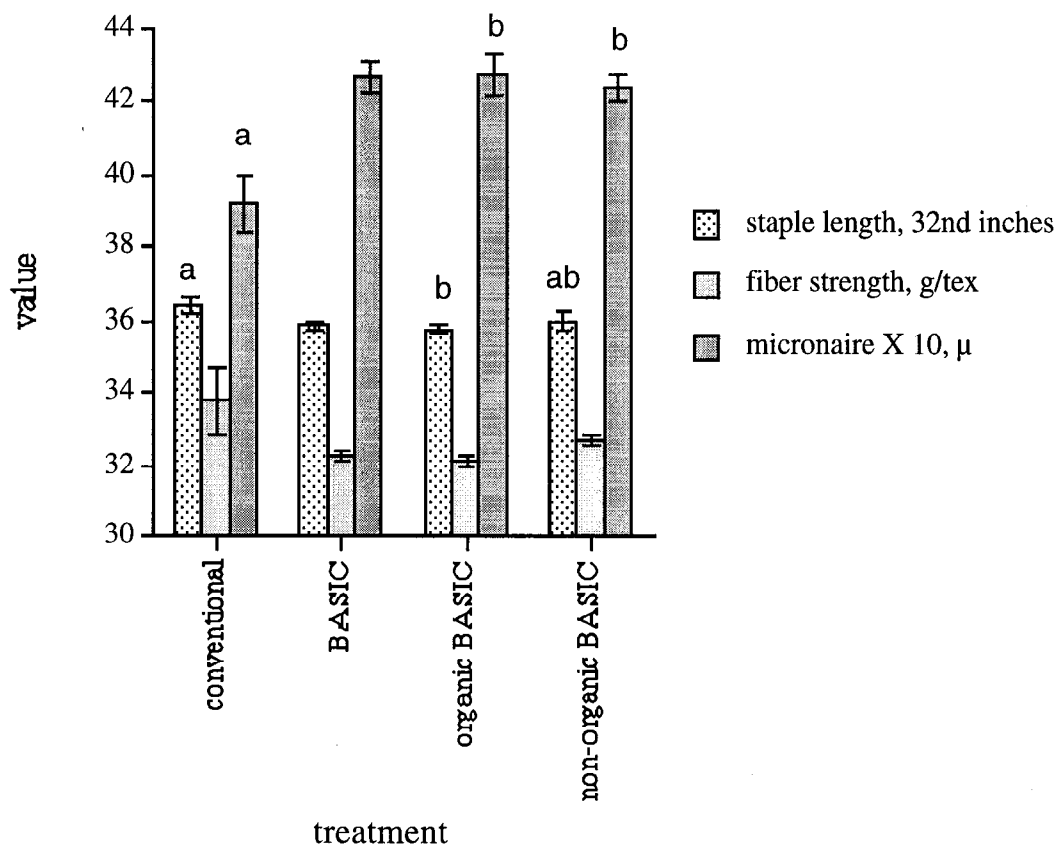


Figure 7c. 1998 BASIC  
leaf material in cotton bales

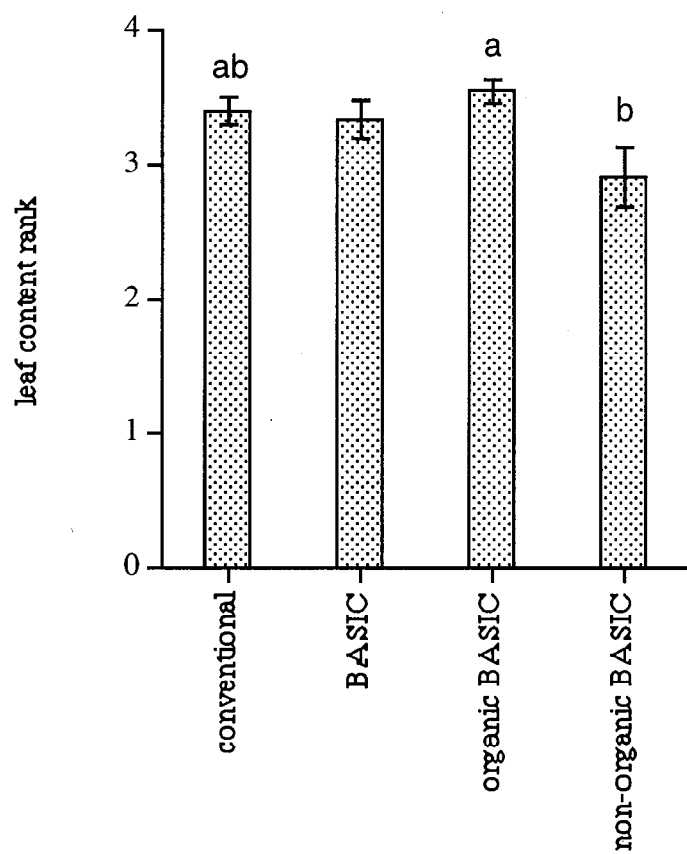
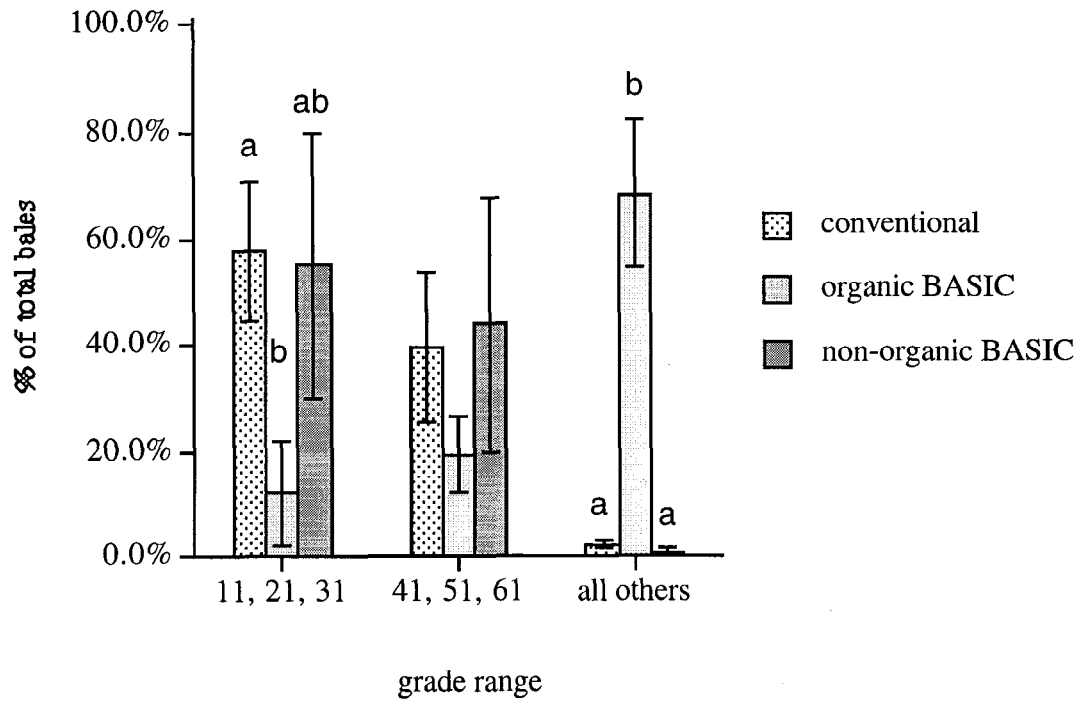


Figure 7d. 1998 BASIC cotton grades  
Percent of bales in different grade ranges



**Table 1. 1997 CASFS BASIC**  
**Average Per Acre Operational Costs and Yields**

		Organic BASIC	Non-Organic BASIC	All BASIC	Conventional Controls
<b>Cultural</b>	Labor	40	38	39	36
	Field power	53	50	51	51
	Materials	124	199	167	288
	Custom/Rentals	310	151	219	103
	<b>Total Cultural</b>	<b>527</b>	<b>439</b>	<b>476</b>	<b>478</b>
<b>Harvest</b>	Labor	23	19	20	17
	Field power	31	32	32	25
	Materials	6	24	17	46
	Custom/Rentals*	0	6	4	9
	<b>Total Harvest</b>	<b>59</b>	<b>82</b>	<b>72</b>	<b>97</b>
<b>Interest</b>		27	21	24	23
<b>Assessments</b>		10	13	12	14
<b>Certification Fees</b>		4	0	2	0
<b>TOTAL COSTS/ACRE</b>		<b>628</b>	<b>553</b>	<b>585</b>	<b>613</b>
<b>YIELD (bales/acre)</b>		<b>2.05</b>	<b>2.52</b>	<b>2.32</b>	<b>2.85</b>
<b>TOTAL COST/BALE</b>		<b>318</b>	<b>224</b>	<b>264</b>	<b>214</b>

\* Ginning costs are paid by the gin, in return for the cottonseed from that cotton.

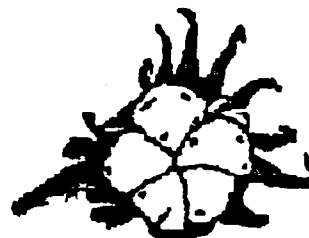
## Appendix B

Farmer Breakfast and field day  
announcements and notes

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# BASIC

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## Meeting Minutes January 29, 1998

The final meeting of the 1997 season was held at Los Tejanos Restaurant in Chowchilla, California. Once everyone had ordered their breakfast, introductions were made round the room and once again, Dr. Sean Swezey UC Specialist at the Center for Agroecology and Sustainable Food Systems in Santa Cruz presented an interesting yet positive audio-visual year end update.

Sean first began by relating his recent trip to the Beltwide Cotton Conferences in San Diego earlier in the month, describing how BASIC was presented to growers and industry professionals from across the nation, and throughout the world. Sean explained that he was presenting the statistical data from the 1997 program and that overall, the BASIC program saw a good year, with a total average yield of 2.5 bales per acre. It was noted that in the future, field histories should be researched, at least minimally, to define the characteristics of the field and project the ability of the soil to handle the crop. Sean stated that there were still grower and gin interviews to be completed and they would have a complete update for the program at that time.

Dr. Swezey continued to explain that although the average was 2.5 bales per acre, the organic actually produced slightly lower than 2 bales per acre this year, which falls outside of the norm we have seen in the past 5 years. Ralph Jurgens explained that was why we needed to have petiole samples taken at various stages of plant growth, so we can pinpoint the cause for the yield difference. He stated that, should the petioles have shown a deficiency, it could have been remedied and the yield would have been higher. This year, BASIC plans to continue the petiole samples, however the tests will include additional information along with Nitrates. Julie Parker asked whether the decrease could be attributed to damage from the flaming cultivator, but Sean explained that the amount of acreage that received flame cultivation was not a large enough area to affect the entire crop yield. Sean and Ralph both stated that the remaining BASIC growers were planted on 30 inch rows with almost twice the plant density, which is an additional reason why the organic performed slightly lower., alongside the early cutout situation.

Sean next touched on the science of plant mapping and its importance to cotton growers. He told how the plant mapping showed the early cutout of the plants and, along with the defoliation problems experienced throughout the valley in 1997, created the decreased yields seen throughout the area. Ralph also explained how monitoring and maintenance of potassium levels in the plants can keep yields up as well, and should be watched in the next year's program. Sean also informed the group that BASIC was looking and the progress achieved through cover cropping and will have statistics and information on this stage of fertilization at a future date.

having the cover crop. Ralph suggests mowing or using a material that does not disrupt the roots and legumes produced beneath the soil, and then incorporate the remaining material into the soil for a buildup of micronutrients and nitrogen. Julie interjected that BASIC was planning to look at the benefits of cover cropping and various other fertility inputs during the 1998 season to provide additional information and more alternatives to its growers, including the planting of edges of fields and/or strips with nutrient producing beneficial habitats to assist with maintenance of soils in the fields.

Sean then touched base on the importance of alfalfa near BASIC fields and the benefits resulting therefrom. He explained how the alfalfa provides a beneficial habitat which also helps to provide lygus with a habitat preferred over cotton, which decreases the lygus actually in the cotton fields. Sean stated that some research had been done in 1997 on a BASIC field by one of his colleagues and the results should be available for review by BASIC some time in April.

Ralph noted how exciting the BASIC program is and how far it has come over the past two years, from the presentations to the data. He continued to state how important the information provided by the BASIC program is and how he couldn't understand why more people weren't listening to what is going on. Not only is the information offered at no cost to the grower, but many of those who have entered into the program have actually saved considerable expense. Sean stated that there were some growers listening, and others watching and that as long as we continue to offer the information and innovative technologies to the growers, more will begin to see the benefits being reaped by their neighbors and, in turn, desire to participate themselves.

A brief discussion then ensued regarding the performance of the flame cultivator in the organic BASIC fields in 1997. Linda Sheppard stated that they had learned a lot that year, especially that the earlier you utilize the flaming cultivator the better weed kill is achieved. The preliminary results are positive, however there will still need to be further research and adjustments to streamline the process. It was suggested that perhaps pre-plant flaming could be a benefit, to kill weed seeds prior to emergence, however Ralph suggested that the machine traveled too fast to heat the ground deep enough to actually kill the weed seeds, yet any that might be on the top of the soil could be destroyed. Sean informed the group that thanks were extended to Pete Cornaggia for all of his work involving the flaming cultivator and the trials he performed on his fields. Will Allen suggested BASIC look at the Texas Rod Weeder next year, which has had promising results with weed control. He explained that the equipment is used when the cotton is young, but strong enough to withstand the stress created by the machine. The group agreed that this implement would need to be looked into in 1998 and tabled it for a possible topic for a future meeting or even a field day.

With that Sean and Ralph concluded the presentations and arrangements were made with Everett Irving of Lemoore Naval Air Station to meet with growers involved in farming on the air base land to show them how to reduce costs and chemicals on their fields sometime in February, 1998. The meeting was then concluded and adjourned.

# BASIC

Biological Agriculture Systems In Cotton

July 1998



## Cotton Pest Resistance

The April 1998 issue of Cotton Farming magazine has a very interesting article on managing pest resistance in cotton.

While still pushing the value of "Drugs" the experts in the field are realizing and advocating the use of beneficial insects. In a 2x6 (approx.) insert labeled "Beneficials Help Control Pests" the article, by Amy Roberts, lists and describes the following beneficials: Green lacewing, Lady beetle, Big-eyed bugs, and Pirate bugs. A picture of a Green lacewing appears in full color.

Another graphic lists "Strategies For Resistance Management". They include: 1. Reduce pesticide use, 2. Use products of different classes, 3. Use cultural and biological control, 4. Understand the effectiveness of materials before using, 5. Rotate materials. This graphic is right next to another labeled "Profit Tip" - "Save time and money. Do not use an expensive application of pesticide that does not work."

So, if you thought that BASIC wasn't feasible or not an accepted practice, check it out— BASIC is the leader in helping you manage cotton pests and cotton pest resistance.

Sandy Sanders - Editor



## LOOK TO THE FUTURE

**FIELD DAY**  
**TUESDAY, JULY 28TH**  
**AT CHOWCHILLA**  
**A**  
**DEMONSTRATION**  
**OF THE**  
**TEXAS ROD WEEDER**

**DISCUSSION OF**  
**APHID PARASITORY**  
**AND**  
**COWPEA TRAP**  
**CROPS**

## GROWER PROFILE:

By Dan Arnold

Claude Sheppard is a fifth generation farmer from Chowchilla, California. The farm he presently lives on has been owned and farmed by his family for three generations. Claude farms 700 acres of organic cotton.

When Claude took over the family farm in '79, he was maintaining good yields using various chemicals. In '86, when his wife, Linda, became pregnant, he began feeling that the pesticides and herbicides they were using had to be getting into the ground water and ultimately into his family as well. Claude began to look for alternatives. What he and hundreds of other growers have found could change the entire farming industry.

Claude says that organic farming isn't a new thing; it has been around forever. He knows that organic farming really (continued page 2, Claude Sheppard)

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## "Cutting Edge"

by

Jo Ann Baumgartner

# "Cutting Edge" Weeding Implements

To say we visited this Lemoore Pima cotton field on a windy day is an understatement, the stop sign were shaking so violently we were not sure if they were going to take off in flight. We had come together with David Vradenburg Sr., of Bezzerides Bros. Inc., and Tim Prather of UC Kearney Ag. Center to check out Bezzerides weeding tools in action. We had seen these tools at farm shows and heard of the successes from farmer friends, so today was a test and an education. David Vradenburg Sr. is the grandson of the founders of the 60 year old family business that has been designing cultivating equipment for row crops, trees and vines. As David readied the tractor tool bar set up, he reminded everyone that ideally the cotton would be cultivated with the same guide wheels that were used at the planting. Even though the crop was flat planted without a guide system in the furrows, accuracy was achieved by setting up the back tools with precision and using a guiding spike directly over the cotton on the front tool bar.

Here's the set up for 2.5" cotton:

First the spider-it loosens up the soil.

Next the knife which follows in line with the spider and slices weeds. Then the torsion weeder-it pushes the soil toward the cotton plant and breaks off emerging weeds in the crust. The spinner is next and is set at an angle to go over the top of the cotton to clean out between the plants. Then guide wheel-it was set at an angle to keep the implements on track. Lastly, the sweeps with side knives to catch any weeds left in the flat furrows. The wind did not blow us away but the weeding tools did! Almost all of the weeds were destroyed. A few cotton plants (about 5%) were taken out by the spinners, but as Rodger Sanders, organic & IPM Bakersfield cotton grower, would tell you, "Initially planting at a higher rate was routinely done in the past to compensate for close weeding. Additionally, the stand is evenly thinned". A quick hand weeding crew sent through the field in the following week will catch any stray weeds left behind. When the cotton is 6" high -time for the next pass minus the torsion weeder switched for a hoe weeder.

## Claude Sheppard

works well because he has been practicing it for the past 6 years, and using a bio-intensive methods for 12. These organic methods are actually attaining as good, if not better, yields than with conventional farming methods. In fact,

***Claude knows  
that organic  
farming really  
works because  
he has been  
practicing it for  
6 years.***

Claude's 1997 cotton yield was 1000 lbs. per acre using no herbicides, pesticides, or conventional fertilizers. Before he went organic Claude would need to use over five tons of chemicals to produce the same yields.

Today organic farming is made easier because there are more resources available. We have an ample supply of technical data, thanks to the Sustainable Cotton Project and Dr. Sean

Sweazey with UC Santa Cruz.

In spite of El Nino, organic cotton is thriving. Too much rain on a field has Claude trying a newly released, faster-maturing cotton. Because of possible fu-

ture shorter growing seasons he has planted a 20 acre test bed in hopes of finding a cotton that will not only mature faster but may help with defoliation problems, now experienced by longer season varieties. In addition, Claude will be able to compare the new cotton quality against the present quality and determine whether or not mills will pay the same for this shorter season cotton.

I asked Claude how the Cotton in the Chowchilla area is doing as compared to other parts of the Valley. Claude says he believes that the cotton in his fields is progressing normally, and this may be due to the fact that no pre-emergence herbicides are used which could potentially cool the soil. Claude feels that his cotton is growing at a normal pace despite the abnormal weather this year and should see blooms around the 4th of July.

## **Sustainable Cotton Project & BASIC**

### **Minutes - July 2, 1998 Field Day**

On July 2, 1998 the Sustainable Cotton Project management team and various other interested parties met at a cotton field located on Dave Stoll's farm. During this meeting, a special presentation was given by David Vradenburg Sr. of Bezzerides Bros. Inc., and Tim Prather of UC Kearney Ag. Center. They demonstrated a cultivator designed not only to remove weeds between the rows but also cultivate the 2" - 6" band of soil next to the plants that is typically left by conventional cultivators. Using this type of cultivation will reduce the need for herbicides and in some instances eliminate the need altogether. This cultivator:

- Replaces disc hillers

- Mulches & aerates soils

- Leaves no objectionable shoulder next to plants

- Conserves moisture

- Breaks the crust, loosens soils & eradicates weeds between the plants

The cultivator can be set up for use on various types of crops such as cotton, corn, cabbage, tomatoes, sugar beets, soy beans and many others. Some of the special tools used on this cultivator are:

- Bezzarides Spider** - Mulch soil & reduce clod formation.

- Torsion Weeder** - Cultivates weeds between plants by rapidly oscillating spring-blades that travel just below the surface. Fractures the row killing small weeds; areates & mulches around the base of the plant.

- Spinner Unit** - Penetrates soil while moving diagonally across the soil creating a lifting action to remove weeds; also breaks crust, areates, mulches. In wetter soils spinners may be used when other tools would too much wet soil.

- Self-Guided System** - Consists of an 8" tilted wheel & furrowing shoe. Allows for faster speed when plants are small.

Points to consider include:

- Mounting tools so they run ahead of a planter to help prevent clogging

- Spider is better than a disc since it mulches row rather than platforms

- More thorough cultivation means less time spent to keep the crop clean

- Cleaner crop means more production & more \$\$\$

- Reduced use of herbicides cuts costs while protecting the environment.

- Faster cultivator speeds (5mph) mean less time in the field & reduced fuel.

- Tools are reasonably priced; a full set of tools costs approximately \$600 per row.

The management team had a lunch/meeting at Harris Ranch. We discussed and agreed to the following:

- The next Field Day will be held July 28th at the Sheppard Farm.

- Field speaker will be Rodger Sanders.

- Field demonstration will be the Texas Rod Weeder.

- Lunch will be held at Los Tejanos in Chowchilla.

- Special speaker after lunch will be Kris Godfrey Ph.D. Associate Environmental Research Scientist at California Department of Food & Agriculture.

- Grower Outreach Program - ad to run in the Merced Sun Star for one week; it will advertise a free IPM program for 30 acre test fields - certain stipulations will apply.

- Discussed Newsletter ideas, ie. layout, topics etc. Dan Arnold to conduct grower profile.

Respectfully submitted by Dan Arnold

**Presentation by Rodger Sanders: Texas Rod Weeder**

A Texas Rod Weeder is a spring wire rod that rides behind the shovel of a cultivator and sweeps up against the row itself traveling just under the surface of the ground. This unique tool can actually remove small weeds from the cotton row. The cotton needs to be at least 8 inches high before this tool can be used. Similar to the Bezzerides cultivator, it also fractures the soil thus killing small weeds. The owner of Bezzerides, David Vradenburg, said the rod can be mounted up a little higher thus cutting the weeds even better.

**Presentation by Linda Sheppard**

In a field being chopped by a weeding crew, Linda spoke on the costs of organic farming. She explained that while organic farming can reduce the expense of applying herbicides and pesticides, it can actually increase the costs of manual labor. Costs per acre for organic farming can average \$75 to \$100 but this year it has cost between \$135 to \$140. Though if you have a very weedy field, the costs could be as much as \$220 per acre. Linda also pointed out that even conventional farmers are being forced to spend more for weed control this year. Most growers are applying more chemicals and some are chopping cotton as well.

**Presentation by Claude Sheppard**

Claude showed a tobacco topping machine that he had purchased three years ago for topping his cotton. The topper has blades similar to a lawn mower. Claude modified the machine to cut six rows; it is pulled by a John Deere high-cycle tractor. Because the cutter is all hydraulically operated, the tractor had to be modified as well. Claude likes his cotton waist high so that means usually only 6-8 inches are cut off. This causes the cotton laterals to grow outward instead of up. It will also cause the plant to mature earlier because sunlight is able to get down into the plant. Claude warned that chopping too short could damage the upper crop, and, not to chop during temperatures over 100. Typically chopping is done the last week of June or the first week of July. The first year Claude chopped every other six rows, and yes, there was an increase in yields on the chopped rows. And, Claude says it beats Pix because it is a one time application versus 3-4 applications of Pix. As Claude sees it, chopping brings about larger laterals with larger node spacing and more and larger bolls that mature faster; while Pix, on the other hand, Pix can shut the plant down. Will Allen commented that at a recent Ag. meeting he had attended, a Pix representative had made the statement, "Pix may not pencil out, but you should use it anyway just in case." Linda Sheppard, who also attended the same meeting, said she was really concerned when this same Pix representative said they don't know how Pix works.

**Presentation by Polly Goldman**

At Bill Chandler's farm, Polly took some insect samples and briefly explained the U.C. Santa Cruz insect monitoring methods. Each week insect samples are taken from each of the BASIC fields and the conventional check fields. Within those fields, samples are gathered from four different quadrants. They also check nearby alfalfa fields to see if they are acting as a lure for various insects.

**Presentation by Chris Godfrey from the U.C. Davis Ag. Extension**

At lunch, Chris Godfrey, an Entomologist at U.C. Davis gave a talk and slide presentation on the cotton aphid. She has been working with the USDA research center, currently surveying 16 sites in Kern County. Her surveys are conducted in several different crops besides cotton. She has two years worth of data gathered on various types of Aphids and parasites in those fields. She mentioned that Aphids are not showing up in cotton fields this year and she is not sure why but thought it could be caused by a naturally occurring fungi that grows during the late fall, winter and on into spring. This year's wet weather may have extended the fungi growth season. The best parasite to the cotton Aphid is a small wasp discovered in a cotton field in China in 1997. Chris reported that in August they will have permission of the State to bring in a fungus that is found mostly in the southeastern U.S. The fungus works by getting on the aphid and then the Aphid takes it back to it's nest. However, they are not sure if it will work here because of the dryer weather.

In addressing the availability of the two Aphid controls, Chris stated that the wasps will eventually be grown in insecteries but could take 3-5 years, and they are trying to get the fungi to naturally occur here in California. If they have to wait for approval to apply the fungi, it could take ten years. Chris also mentioned that Initiative 2000, promoted by Clinton and Gore, is aimed at eliminating all pesticide application by the year 2000.

Asked if this wet year had caused more insects, Chris said that in fact she had found less, and the Aphids she has found are diseased. On the subject of survivability of predators released by machine versus released by hand she stated that they get the same survivorship.

# BASIC



*Biological Agriculture Systems In Cotton*

Sandy Sanders, Editor (805) 837-0181

July 28, 1998

## GROWER PROFILE: RODGER SANDERS

Bakersfield farmer Rodger Sanders is a consultant for the BASIC program. He demonstrated the Texas Rod Weeder, a favorite of his, at the July 28th BASIC Field Day at the Sheppard's farm. Rodger's grandfathers farmed cotton in Texas and he and his father carried on that tradition here in California.

Rodger farms with one foot in conventional farming and one in organic farming. He has 500 acres of organic cotton and 700 acres of conventional cotton. Rodger believes that the secret to farming organically, or low input, has to be the simple rotation of cotton or other cash crops with cereal grains (oat, wheat, barley) and legumes (alfalfa, beans, or vetch). "We are learning this after farming cotton on land as many as 10 -15 years straight. The high cost of water (\$100 per ac. ft.) leaves the farmers with very few choices in our area. We must force ourselves to get away from mono-culture systems to succeed for fertility and correcting weed problems, through summer fallow programs."

A diversified farmer, Rodger also grows fruits and vegetables for a CSA (30 families who pay a subscription fee for a box of produce once a week) and for Certified Farmers' Markets from Santa Barbara to Hollywood. He has been

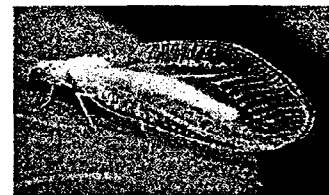
growing his fruits and vegetables organically for over twelve years.

Before going organic on the cotton acres, Rodger had been reducing his chemical inputs each year to the point that there were years that he didn't spray at all. By taking a "wait and see....let's think about it for a few days" attitude, Rodger found that, more often than not, the beneficials got the upper hand on the problem.

### GREEN LACEWING: MANAGING COTTON PESTS

Green Lacewing

**Description:** A beneficial predatory insect that attacks insects and insect eggs, such as aphids, small caterpillars, mites, whitefly, scale, mealybug, thrips and other soft-bodied insects.



*Green Lacewings are important predators of bollworm eggs and larvae.*

**Lifecycle:** At 80 degrees F, larvae emerge from eggs in 2 to 4 days from time of delivery. In warm weather, larvae can walk up to 7 miles, usually staying in a concentrated area. Larvae move from plant to plant, if leaves are touching,

## GROWER PROFILE **contin-**

Rodger sees IPM as the way of the future and would like to see the BASIC program implemented in his area of the valley. "There have already been a couple of farmers near me that are asking me about IPM. I think it's time to spread the word."

## LACEWING **continued**

traveling faster on smooth leaves, slower on rough or hairy foliage. For each 5 degrees higher temperature, larvae will clean up aphid infestations a week sooner (higher metabolism makes them eat more). About 60 degrees F minimum temperature is required for eating and egg-laying.

### **Lacewing's Favorite Habitat:**

Annual or reseeding borders of early grasses, sorghum, corn, sunflower, legumes or Brassicas are good places for spring releases to yield large movements of adults into later plantings of cotton. Hedgerow borders of perennials blooming various months of the year with large bunches of tiny efflorescences help feed adult lacewing and other beneficials. Adjacent unsprayed grain and oilseed fields can supply 4-12 predators per cotton plant, controlling aphids and can reduce moth eggs.

### **Releases**

Frequency and quantity of releases can vary with size and type of pests, other predators and parasite populations, and temperature.

Farming ecologically with biological control inputs can save 50 to 75% over conventional chemical pest control. Resistance problems, and outbreaks of

secondary pests are avoided. The failure of pesticides resulting in a pesticide treadmill creates monster pests, particularly aphids, whiteflies, and leafminers which spread crop diseases and can be prevented.

Minor adjustments in the way we farm, along with early releases with commercial natural enemies, can maximize nature's great free resources of biological pest control.

*(Information from Rincon-Vitova Insectaries, Inc. of Ventura, CA (800) 643-5407)*

Cocoons yield  
adult green lacewing  
in about 5 days.

Adult lacewing migrate  
toward nectar, pollen  
or insect honeydew  
before laying eggs.

Sugar sources attract adults.

Adults can lay up to  
600 eggs on  
hairlike filaments.

## **COTTON MARKET: Guest opinion from Mark Thompson of Thompson Cotton/TC Review**

**I**t seems we're back to square one. The market appears to have run out of steam. The market rally we've had over the last couple of months or so was mostly weather driven. A 14.5 million bale crop is probably in the market already.

Traders have changed their attentions to the demand side of the equation. Demand appears to not look good both in the U.S. and especially internationally. Asia, which is our biggest market, is not improving - maybe even worsening. Both wool and polyester prices are at record lows. One would hope cotton prices don't get pulled down with other commodities.

Another focus in traders minds are once again Step 2 market certificates (incentives). It could

be possible that US mills are full of unsold yarns because in order to receive market certs they are supposed to open, which means **Spin**, this cotton. Also, I think US merchants are shipping unsold cotton to Mexico, Canada and a few other locations. This could be very bearish to our market, some think - in the sixties again. The market will probably trade sideways in a range until more is known about US and world cotton crops. By the way, these are normal July/August trading patterns.

*Mark is a former cotton broker for Anderson/Clayton. He has gone on his own now with Thompson Cotton. Call (209) 277-6902 to talk with him, and be sure to ask about his TC Review.*

## **LOOK TO THE FUTURE**

### **The August Presentation Will Be**

## **COVER CROPS**



**A Cotton Farmers' Prayer  
Come October  
may all our fields  
be filled with bolls  
like the one above.**

## **THE BASIC MANAGEMENT TEAM**



*Bezzarides Field Day @ Dave Stoll's Farm 7/2/98*

The BASIC management team :

Will Allen: Director of the Sustainable Cotton Project

Jo Ann Baumgartner: Assistant Director of Sustainable Cotton Project

Linda Sheppard: Grower Outreach Coordinator

Eric Sotelo: Administrative Assistant for Sustainable Cotton Project

Sandy Sanders: Publications Coordinator

Dan Arnold: Contributing Feature Writer and Photographer

Sean Swezey: U.C. Agriculture Specialist

Polly Goldman: U.C. Post Graduate Researcher

Rick Reed: Program Developer

Claude Sheppard: Grower/Consultant

Shawn Moss: Grower Consultant

Eddie DeAnda: Field Scout

## BASIC

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State/Province \_\_\_\_\_

ZIP/Postal Code \_\_\_\_\_

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BASIC

Biological Agriculture Systems

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Chowchilla, CA 93610

## FIND OUT MORE

If you would like more information about BASIC and the Grower Outreach Program that will supply a free IPM program for a thirty acre test field (certain stipulations will apply). mail in the information slip.

# BASIC

*Biological Agriculture Systems In Cotton*



Sandy Sanders, Editor (805) 837-0181

September 1998

## GROWER PROFILE by Dan Arnold

**T**his month's profile is with BASIC grower Bill Chandler and his wife Nancy. Their neatly kept Farm is located just south of Chowchilla. Driving to their humble abode, I knew that these folks really love farming. Their driveway is lined on the one side with a neatly stacked mountain of straw and various farm implements aligned in rank on the other; it gave a warm salute as I entered.

Bill is a second generation farmer. His dad purchased the home place of 133 acres in 1963 and Bill still farms it and another 100 acres today. Altogether, they farm 83 acres of cotton, 36 acres of alfalfa, 50 acres of corn, 37 acres of wheat, and 27 acres of oats. Bill likes to use a combination of conventional and sustainable farming methods. For the past four years he has planted black-eyed peas in his cotton, lining it on each side with two rows and 2 rows down the middle. Bill knows it really works: "There are a lot of aphids in those peas and few in my cotton." This year he planted C-5 peas but says the bushier #46 peas make for a better bug lure. He also has been using beneficial insects for the past 10-12 years. Bill also has applied dusting sulfur but says that doesn't always work well on everything and hasn't used it for the past three years.

I asked Bill if he used any special planting or fertilizing techniques handed down from his father. He replied, "Nothing that other farmers don't use." Bill said he applied Staple this year but said he's not sure if it really works. The Staple costs him about



Bill and Nancy, with their trusty John Deere, are real down-to-earth folks with a will to work and a love for their farm.

\$10 per acre to apply but believes mixing it with Prism and Crop Oil, in equal amounts with the Staple, may have diluted the Staple too much. With a sigh of complaint, Bill commented, "Nothing seems to be working this year, the weeds seem to just keep growing." Bill plants 50,000 cotton plants per acre on 38 inch rows and says that planting thicker seems to give him the best yields. In the past he has planted Thyto-gen 33 cotton but the bolls set higher and the turnout is about 1.5% lower. This year he has planted GTO Maxxa and is anxious to see how it will produce.

When asked if there was anything that BASIC could do to help him, Bill's reply was, "a dollar a pound for my cotton would be nice."

# FIRST-EVER ORGANIC COTTON DIRECTORY

The Organic Trade Association's Fiber Council, in collaboration with the Pesticide Action Network, is offering the first-ever Organic Cotton Directory.....a comprehensive guide for organic cotton companies and their products. More than 125 companies listed offer an exciting range of organic cotton products for men, women, children and infants: apparel, sportswear, undergarments, sleep wear, personal hygiene items, tampons, diapers, bed and linens, sheets, toys and much more!

The Directory contains listings and complete contact information for organic cotton growers, brokers, mills, manufacturers, wholesalers and retailers providing a complete networking tool for the growing organic cotton industry. The Directory also includes hard-to-find information on the organic cotton market, world acreage and environmental and human health problems associated with conventional cotton production.

New Strategies adopted by the apparel industry, such as blending organic with conventional cotton, are stimulating a renewed demand for organic cotton, which is currently at an all-time high. Acreage estimates for the 1998 organic cotton crop are up by 11% to more than 10,000 acres. This represents a total reduction of approximately 3 million of synthetic pesticides and fertilizers typically applied to conventional cotton. Organic cotton farmers use natural farming methods such as crop rotations, cover crops and compost to build soil fertility and beneficial insects to manage pests. By choosing organic cotton, consumers can make a difference in how cotton is grown in the U.S..

The Organic Trade Association (OTA) is the business association representing the organic industry in the United States and Canada. OTA's 750 members include growers, processors, shippers, retailers, certification organizations, and others involved in the business of producing and selling organic products. The Organic Trade Association's Fiber Council (OFC) represents all

sectors within the organic fiber industry, including organic cotton farmers, manufacturers, wholesalers and retailers involved in the organic fiber industry. Pesticide Action Network (PAN) is an international organization working to replace toxic pesticides with ecologically-sound alternatives. PAN promotes organic cotton by generating consumer awareness around pesticide use in cotton and its impact on human health and the environment.

## Cost and ordering information

**Non-OTA members: \$15 + \$3 shipping & handling.**

**OTA members: \$10 plus \$3 shipping and handling.**

**Phone orders: Tel: 413-774-7511**

**Fax: 413-774-6432**

**Address: P.O. Box 1078**

**Greenfield, MA 01302**

## BIOFACTS:

### What's Happening in the Field?

**Chowchilla: Claude Sheppard....**

For our BASIC growers we are doing the last releases for aphids, and counting the bugs in the fields. In two fields there is some concern with the aphids so we are going to make another beneficial release today (Friday, 9/4) We are trying to make sure that growers will not have to spray for aphid. As for the mites and lygus, we seem to have them under control...It is all behind us.

The other things we are doing are finishing water and the means for defoliation. That is why we are having the Field Day September 9th...to discuss what to use for defoliation. We know that this a major concern for growers.

## *Sustainable Farming: View Point from a "City-Slicker" / Once-Farmer by Dan Arnold*

**C**ertain aspects of farming really haven't changed much from the way it used to be. Farmers are still talking about the weather and low prices for their crops. However, farming methods certainly have changed since the 60's and 70's. I really can't call them farmers anymore. They're more like "Agriculture Engineers" or "Botanical Specialists"! With the introduction of the Internet, how about calling them the "Super-Cyber Farmers"? Okay, maybe I am getting carried away, but farming sure isn't what it used to be.

Growing up on a farm in Northeast Kansas was, as I recall, a lot of hard physical work with very little thanks from anyone, especially the "City Slicker" as Dad called them. Though I am a city slicker, my heart still longs for the country. I remember some of our "high tech" equipment like a 1948 Farmall model H tractor and an old iron plow that came out of the ground with a quick, hard tug from a rope...well it worked anyway. It had air-conditioning too, that is, if the umbrella didn't twist around. Ha!

Today's farming appears to be more like science and is an enormous business venture rather than a career. Farmers spend a lot of hard earned dollars on pesticide/herbicide applications, high tech soil conditioners or other new ideas learned while attending yet another Ag extension meeting. Makes you wonder who is really in control of your farm. The 21st century farmer will certainly be faced with many new ideas and even greater challenges. Certainly tougher environmental controls and greater demands will be placed upon them but there are a lot of

good ideas emerging that I feel the next generation could really use. For instance, organic farming, or at least some level of sustainable farming really works. Chemical companies may be afraid to admit it, but I believe the use of beneficial insects and getting back to some of the "old ways" is a wise choice. Planting cover crops instead of applying expensive fertilizers or soil conditioners are proven methods that really work. Are the expenses involved with getting that extra yield really worth it or can we use some of the old methods and still produce the same crop? Granddad Raymond Sheppard, 82 years young would say yes. He started farming in 1943 and found that crop rotation or planting a cover crop worked just fine. I know equipment can be expensive, but where I grew up, neighbors helped each other, one planted, the other harvested.

I've been thinking about trying to get back into farming but am afraid of the initial expense, and I have heard that being concerned with the environment as a farmer is somewhat taboo. I would like to ask the question then, why shouldn't farmers be concerned with protecting their environment? After all, it belongs to you not the chemical companies. Our children and grandchildren are the future of farming. Are we more concerned with making money than our children's health and future? I know, I'm just a City Slicker. But I am reminded of a bumper sticker from Cascadian Farms (farming organically for over 25 years) that really says it all....

*Live Like You'll Die Tomorrow  
Farm Like You'll Live Forever*

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**BASIC**

***Biological Agriculture Systems In Cotton***

**23199 Road 7, Suite B**

**Chowchilla, CA 93610**

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**Mailing  
Address  
Goes  
Here**

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**BASIC**

**Biological Agriculture Systems In Cotton (BASIC) strives to assist growers in cost effective methods of farming in a world of increasing costs and regulations.**

**If you would like more information on the BASIC program, please call:**

**Will Allen @ (530) 589-2686**

**Jo Ann Baumgartner @ (408) 471-9915**

**Linda Sheppard @ (209) 665-3925**

**Eric Sotelo @ (530) 589-2686**

There are many concerns when using defoliants on cotton. Herbicidal Defoliants can harm other crops and vegetation as noted by David J. Moorhead, Associate Professor of Forestry, University of Georgia. Located on his web site, ([www.bugwood.caes.uga.edu/factsheets/html/cottonpine.html](http://www.bugwood.caes.uga.edu/factsheets/html/cottonpine.html)) is an interesting article concerning the effects that herbicidal defoliants are having in his area, especially on the Georgia Pines. His web site shows pictures of the defoliation burns associated with herbicidal defoliants. Not a pretty picture, yet cotton farmers know that poor defoliation will lower yields and fiber quality. Defoliation too early can lower micronaire and too late can increase the likelihood of lint damage or loss due to weathering. Defoliation, often referred to as the "D" word, is taboo to the organic cotton industry, yet there are alternatives to herbicidal defoliants. For instance, hormonal defoliants only affect cotton or related species such as velvetleaf. These hormonal defoliants actually use the cotton hormone ethylene to further stimulate ethylene synthesis resulting in an abscission zone in the boll walls and leaf petioles thus acting as a defoliant. Since these hormonal-type defoliants bypass the herbicidal injury, they are not as likely to cause desiccation (leaf sticking) as herbicidal defoliants. Dropp and Prep are hormonal defoliants. Natural occurring substances can produce similar effects. For example, Sodium Chlorate is made from electrified salt and water, with an added fire retardant. Farmers have been using it for years with little, if any, known side effects. Yet the USDA, EPA and organic certifications will not recognize or authorize its use as an organic cotton defoliant. Interestingly, in July of this year the USEPA granted a request by the State of Mississippi for an exemption for a tolerance of residues for sodium chlorate to be used on wheat for an additional 1 1/2-year period, ending Jan. 30, 2000. The EPA concurred with Mississippi's state of emergency and was permitted to use it on wheat "due to continued

heavy rains resulting in the need for a harvest aid to desiccate winter weeds, which developed in the thin strands of an already diminished crop." ([www.mailgate.org/mailgate/GOV/gov.us.topic.agri.farms/msg00242.html](http://www.mailgate.org/mailgate/GOV/gov.us.topic.agri.farms/msg00242.html), page 2) Wheat is ingested, as well as cottonseed oil, why shouldn't it be used as an organic cotton defoliant? If interested regulators want to provide a "Farm Aid" for organic cotton growers, then a variance should be granted. This variance might only last for a specified length of time, perhaps for only 5 years or until a new organic defoliant is developed. If the fire retardant Urea is a concern there are other safer substitutes, i.e., soda ash or sodium metaborate. Certain parts of the US such as Texas and Tennessee may not need to use a defoliant, where early frosts occur. However California rarely sustains a hard frost. Where is our harvest aid?

In summary, herbicidal defoliants are harmful to other living organisms and their use should be greatly reduced, if not banned altogether, yet defoliation is a critical concern for the future of organic & sustainable cotton farming. This year a reputable mill offered a contract for 2000 bales of pending cotton (meaning a program leading to certification). Growers were interested until they learned they couldn't use a defoliant. The "D" word strikes again!

We would like the EPA to consider now that the opportunity to plant other cotton varieties in the San Joaquin Valley (besides Acala & Pima). We should experiment with known varieties that produce high yields of lower grade cotton, which also defoliates easier. Having such alternatives as natural ethylene's and even lower toxic sodium chlorates during the testing period for these new varieties would greatly aid growers trying to use less toxic defoliants. Since defoliants use hovers around 6 million pounds, any significant reduction would be helpful.



## **BASIC Hosts Tours**

BASIC hosted three tours this fall. The first tour included various representatives from Patagonia, Parkdale Mills and of course the BASIC Team members. After gathering at the Sheppard farm for a scrumptious lunch, Linda Gross made an informative presentation of the Sustainable Cotton Project's new "Cleaner Cotton Campaign." The program will be launched over the next five years and hopes to boost markets for organically grown cotton products. In addition, we hope to build a team of professionals creating a coalition of farmers, manufacturers and consumers that will substantially increase California organic cotton acreage. Pictured below is the group standing in front of Claude Sheppard's Cotton Picker.



The group then drove out to a cotton field near Chowchilla to see a crop of new shorter staple cotton authorized by the state of California for the first time this year. The tour ended later in the afternoon with words from Parkdale that they will consider buying more organic cotton.

Then on October 23, Wilhelm Hernberg, an investor from Bremen, Germany, came with 80 of his clients to see the San Joaquin Valley. He located Claude's farm through his Web page and decided he must visit his farm. Though few spoke English, a common farmer bond could be felt as Wilhelm interpreted. Some had

never seen cotton growing and did not know if it were planted as a seed or a plant. Wilhelm said he was interested in organic farming and asked several questions concerning the matter. Pictured below are Wilhelm and Claude.



Again on Nov. 6, BASIC hosted yet another spectacular group, with visitors traveling from as far away as Scotland. Also present was Mr. Duncan Berry, representing Target and Wal-Mart Corporations. We were also delighted

to have several EPA representatives, including Tim Hatten take time out to meet with us, as well as Ray Greene, Chief Administrator for the California Organic Certification Board and a farm magazine news reporter. The day began with a tour of the Anderson-Clayton Cotton Gin near Chowchilla, CA. Thanks to Steve Sansabastian for the fine tour. We then made our way back to the Sheppard's farm and ate a delicious steak lunch with all the trimmings. Ed Davis spoke, promoting organic cotton and solicited various questions from the group. Will Allen enlightened the crowd concerning Basic's role and its desire to see more organic fiber being used by consumers. After lunch we walked out to a nearby field where cotton was being harvested and Claude ably spoke of the differences between organic and conventional farming methods. He voiced his concern for the environment and all of the harmful chemicals present in the air at this time of the year. The day came to an end with a promise from Mr. Berry that it was time for him and his associates to make a contribution to organic cotton. We hope these tours will stimulate the market for organic cotton and make known the concerns of the organic farmer.

Pictured below is Claude speaking to the tour group.



## **DEFOLIATION (The "D" word)**

California cotton farmers are quite familiar with defoliation but for the organic farmer defoliation isn't a simple matter, especially since there are no excellent organic defoliants available. Various home remedies have been tried but are limited in their ability to truly defoliate or aid in opening bolls. An article written by Keith Edmisten, Crop Science Extension Specialist states, "For successful defoliation the leaf must stay alive long enough to begin the formation of an abscission zone that results in leaf drop. If the leaf is killed too rapidly, the result is a leaf that is frozen or stuck to the plant creating unnecessary trash." Proper defoliation is a profitable part of a total cotton management system. The benefits are obvious. Elimination of the main source of stain and trash resulting in better grades, more efficient picker operation, quicker drying of dew, allowing picking to begin earlier in the day and the potential stimulation of boll opening increasing yields and profits, something all cotton farmers need more of. With soaring costs associated with cotton production, farmers are being forced to squeeze every dime out of their farms. With slumbering conventional cotton prices averaging only \$.62/lb., farmers might want to consider becoming a BASIC grower and earn as much as \$1.00/lb. for transitional cotton.

## Appendix C

### Sample farmer update (August)



CENTER FOR AGROECOLOGY  
AND SUSTAINABLE FOOD SYSTEMS

SANTA CRUZ, CALIFORNIA 95064

31 August 1998

Dear cotton growers:

Enclosed is the first set of updates from the 1998 BASIC plant mapping and insect sampling efforts, extending to the month of August. Fields have codes as in prior years; however, some codes may differ from prior years. This is your code:

Code: trtmt \_\_\_\_\_ rep: \_\_\_\_\_

Tables: Each number on the tables represents an *average*. For the sweep net samples, each number is an average of four 50-sweep samples on each date in each field. For the plant map samples and the leaf insect samples, each number is an average of 20 plants or 20 leaves on each date in each field. We have added a column for percent mite infestation. Some fields have not been sampled every week. Wet fields, fields that have been sprayed, and sometimes time constraints prevent us from reaching every field each week. These tables are not intended to substitute for pest control information and recommendations made by a licensed pest control advisor.

Graphs: Graphs show a picture of averages for each treatment (BASIC or check), to give you an idea of how the two treatments are performing overall in time. The horizontal axis goes from June 10 to August 28. For the sweep net sample graphs, the vertical axis is the average number of insects per 50 sweeps with a sweep net. For the leaf insects (mites, thrips, and aphids), the vertical axis is an insect rank: a value of 1 corresponds to no insects, 2 means up to 10 insects, 3 means up to 100 insects, and 4 means over 100 insects per leaf. We have also included a graph of average percent mite infestation.

*What do the graphs mean?* Thrips and aphid populations have remained very low through July, but mite infestation has been high. Lygus populations increased in July and in the last few weeks. Beneficial insect numbers (mostly bigeyed bugs and minute pirate bugs) have been higher in BASIC than in check fields throughout the 1998 season.

BASIC and check fields have maintained fair retention of the bottom five fruiting positions; but not as high as last year at this time. Top five retentions are beginning to decrease as plants go into cutout. BASIC fields closely parallel check fields in node number, plant height, and number of fruiting branches, and are slightly ahead of check fields in these parameters at this time. The season is clearly going to be a late one, as most of the fields have not yet cut out (five to six nodes above white flower).

If you have any questions about these graphs or charts, please feel free to contact Sean Swezey at (408) 459-4367, or come to our next breakfast meeting, which will be announced in the mail.

Sincerely,

A handwritten signature in black ink, appearing to read "Sean Swezey".

Sean L. Swezey and Polly Goldman  
Center for Agroecology and Sustainable Food Systems  
University of California  
Santa Cruz, CA 95064  
(408) 459-4367

date	trtmt	farm	lygus	bigeyed bugs	minute pirate bugs	damsel bugs	assassin bugs	ladybird beetles	lacewings	spiders	immature beneficials	total beneficials
6/19	B	11	0.25	0	0	0	0	1.25	0	1.25	0	2.5
6/19	B	12	0	0	0	0	0	1.5	0	0.25	0	1.75
6/19	C	12	0.25	0.5	0	0	0	0.5	0	0.25	0	1.5
6/26	B	1	1	0.25	0.75	2.25	0	1.5	0.25	2.25	0.5	7.25
6/26	B	2	2.25	0	0.75	0.5	0	1.75	0	3	0	6
6/26	B	3	0.75	0.5	0	0.5	0	0.5	0	1.5	0	3.25
6/26	B	4	0	0.25	0	0.25	0	1	0	3.25	0.25	4.75
6/27	B	11	1.25	1.75	2.5	0	0	0.75	0	3.25	1.5	8.25
6/27	B	12	0.25	1.25	2.25	0.25	0	3.25	0	1.5	0.25	8.5
6/26	C	7	2.5	0.25	0	1	0	0.25	0	2.5	0	4
6/26	C	8	0.75	0.25	0.25	0	0	1.25	0	1.75	0.5	3.5
6/27	C	12	0.75	0.25	1.75	0	0.25	3.5	0.25	0.25	0.25	6.25
7/1	B	6	0.75	0.5	1.25	0	0	0	0	2.25	0	4
7/1	B	7	1.5	0.75	0.75	0.5	0	0	0.25	2.25	0.25	4.5
7/1	B	8	1.75	0.75	0.5	0	0	0.5	0.25	0	0.5	2
7/1	B	9	0	0	0	0	0	0	1	1.75	1	2.75
7/1	C	5	1.25	1	1.75	1	0	0	0	1	0.25	4.75
7/1	C	6	1.25	0	1.5	0.25	0	0.5	0	1	0	3.25
7/1	C	9	0.375	0.25	0	0	0	0.125	0	2.25	0	1.5
7/1	C	10	0	0.75	0.5	0	0	0.5	0	0.5	0.25	2.25
7/8	B	1	5.75	2.5	2.25	10.75	0	0.5	2.5	2.5	2.25	21
7/8	B	2	3	1	1.5	4.75	0	0.5	1.5	1.75	1.75	11
7/8	B	4	5.5	2.25	1.5	1.5	0	0.75	0.25	1	1	7.25
7/8	B	5	0.75	2	0	0.25	0	0.5	0	0.75	0.25	3.5
7/10	B	6	3.75	4	3	4	0.25	0.25	0	0.75	2.75	12.25
7/1	B	7	0.25	3.75	1	0.25	0	0	0	0	2.5	5
7/10	B	8	4.25	1.25	2.75	2.25	0	0	0	1.25	0.25	7.5
7/8	B	9	1	3.25	0.75	2.25	0	0.5	0.25	0	0	7
7/10	B	11	5	2.5	3.5	8.25	0	1.5	0.5	4.5	0.5	22.25
7/10	B	12	4	3.75	7.75	1.25	0.5	0.5	0.25	1	0.25	15
7/8	C	2	4.25	2.75	0.25	0	0	0	0.25	3	0.25	6.25
7/8	C	4	6.75	0.75	1.25	9.25	0.25	1.75	0	1	0.25	14.25
7/10	C	5	3.25	2.75	2.5	4.5	0	0.75	0	2	0	12.5
7/8	C	6	5.25	1.25	1	0	0	1.25	0	2	0	5.5
7/10	C	7	5.75	0.5	1.25	0.25	0	0.5	0.75	2.25	0.5	5.5
7/10	C	8	3.25	2.5	2.5	3	0.5	1.25	0.25	2.75	0.5	12.75
7/8	C	9	5.75	4.5	2	4.25	0.25	1	0	2.5	0	14.5
7/10	C	10	6.75	6.5	1	1.5	0	0.25	0	0.75	1.25	10
7/10	C	11	1.25	0.25	0.75	0	0	0	0	0.5	0	1.5
7/10	C	12	4.5	2.75	5	2	0	0.75	0	0.75	0.75	11.25
7/17	B	1	5.25	5.25	3	5.75	0	0.5	1.5	2.25	3.5	18.25
7/17	B	2	1.25	5.25	3	5	0.25	0	0.25	0	3.5	13.75
7/17	B	3	3	4.75	9	3	0.5	0.5	0.75	2.5	2	21
7/17	B	4	2.5	10.5	6.5	2.5	0	0	2.5	0.5	6	22.5
7/17	B	5	2.25	7.5	2.5	1.75	0	0	1.25	1.25	3.5	14.25
7/15	B	6	2	5.25	4.75	2.5	0	0	0.25	0	5	12.75
7/15	B	7	1.5	0.5	1	0	0	0	0.25	0.5	0	2.25
7/17	B	9	2	15.25	2.75	2	0	0	0	1.25	7.25	21.25
7/15	B	12	2.25	1.75	3.5	0.25	0	0	0	2.75	0.25	8.25
7/17	C	1	6.5	4.25	2.75	3.25	0	0.25	0.25	1.25	0.75	12
7/17	C	2	5.25	2.25	6.5	3.5	0	0.25	0	0.25	0.25	12.75
7/17	C	3	1.25	8.25	2.75	1.75	0	0.75	0	0.75	5	14.25
7/17	C	4	1	1.75	0	0.25	0	0.25	0	0.25	0.75	2.5
7/17	C	6	0.75	1.75	0.75	0	0.25	0	0.25	0.25	0.25	3.25
7/15	C	7	1	1	1.5	0.5	0.25	0.5	0.5	0	1.25	4.5
7/15	C	8	1.5	1	0.75	0	0.25	0	0	0	0.25	2
7/17	C	9	0	1.25	0	0.25	0	0	0	0	0.25	1.5
7/15	C	10	0	0	0	0	0	0.25	0.25	0.25	0.25	0.75
7/15	C	12	8	5.25	7	1.5	0	0	0.25	1.25	1.75	15.5

date	trtmt	farm	lygus	bigeyed bugs	minute pirate bugs	damsel bugs	assassin bugs	ladybird beetles	lacewings	spiders	immature beneficials	total beneficials
7/24	B	1	7	12	12.5	5	0.25	0.5	0.75	1.75	9.5	32.75
7/24	B	2	6.5	8.25	7.75	7.75	0.25	0.25	0.25	0.5	9	25.25
7/24	B	3	4	11.75	12	2	0.5	0.5	0.5	1.5	5.25	28.75
7/24	B	4	1.5	13.25	6.5	1.75	0.25	0	0	0.5	2.5	22.25
7/24	B	5	4.75	9.75	2.75	8.75	1	0.75	0.25	0.25	2.75	23.5
7/22	B	6	5.75	19.5	5.5	3.5	1	0.25	0.25	0.5	8.75	30.5
7/22	B	7	4	1.75	3	0.25	0	0.5	0.5	0.25	0.75	6.75
7/22	B	8	6.75	9.25	15.75	5	0	0	0	0	14.5	30
7/22	B	9	0.75	13	4.5	1.75	0.5	0	0.25	0.25	5	20.25
7/22	B	12	4.5	0	5	0.75	0	0.25	0.75	10.25	0.5	17
7/24	C	1	3.25	1.5	4.25	0.5	0	0.5	0.25	0.75	0.75	8
7/24	C	2	1.25	1.5	1.25	0	0	0	0.25	0.5	1	3.5
7/22	C	4	3	2.5	6.75	0.75	0.25	0.25	1.25	0.5	1	12.25
7/22	C	5	0.75	1.25	2.5	0	0	0.25	0.25	0	0.5	4.25
7/22	C	6	1.25	1	5.25	0	0.5	0	0.25	0.5	1	7.5
7/24	C	7	0.75	0.5	2.5	0	0	0	1	0.5	3.25	4.5
7/22	C	9	0	3.75	0.5	0.25	0	0	0	1.5	1.25	6.25
7/22	C	10	1	0	0	0.25	0.5	0	0.25	0.25	0	1.25
7/22	C	12	0	0.25	0	0	0	0	0	2	0	2.25
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7/29	B	2	4.25	9.5	3.75	3.25	0.25	0.25	1	0.75	7	19
7/29	B	3	5.5	8.75	6.5	4	0.5	0.25	0.5	0.75	2.5	21.25
7/29	B	4	2.5	14.25	4.5	1	1.25	0	0.5	1.5	9.75	23
7/29	B	5	2	14.25	5.25	6.5	1.5	0	1	2.25	6.25	30.75
7/31	B	6	2.5	5.5	2	0.25	0	0.25	0.25	0	2.25	8.25
7/29	B	7	6	5.75	6.75	0.25	0.75	0	0.25	0.25	3.75	14
7/31	B	8	2.75	3.5	3.5	0	0.25	0	1	0	2.25	8.5
7/31	B	9	4	1.5	1.75	0.5	0.25	0	0.75	2.5	1.5	7.25
7/31	C	1	4	2	3.25	0.25	0	0.25	0.5	2.75	1.25	9.25
7/31	C	5	2	1	6	1	0	0	1	1	2.25	10
7/31	C	7	2	1.75	2.75	0	0.25	0	0.5	0	1	5.25
7/31	C	9	3.5	6.25	0.5	0.25	0	0.25	0.25	0	2.5	7.5
7/31	C	10	2	0.75	0.75	0	0	0.25	0	0	0.25	2
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8/7	B	1	5.5	10	6.25	6.25	0.25	0	0.25	0	7	23
8/7	B	3	4.25	31.25	30.5	6.25	0	0	1.25	0.5	17.75	69.75
8/5	B	6	1.75	3.5	8	0.5	0.25	0	0.25	1.25	1.25	16
8/5	B	7	4.25	13.25	19	0	0.25	0.25	0.75	1	7.5	34.5
8/5	B	8	3.25	16	13.25	1.25	1	0	1	0.5	8.5	33
8/7	B	9	1.5	16	2.5	1.75	0	0	0.75	0.75	4.25	21.75
8/5	B	12	1.75	0.25	10	0	0	0	0.5	0.75	0.5	11.5
8/7	B	13	2.75	0.5	13.75	0	0	0	1	0.5	0	15.75
8/7	C	1	1.5	6.25	4.75	0.5	0.75	0.25	4.25	0.25	6.75	17
8/7	C	2	1.5	5.25	5.5	0.25	0	0	1.25	1	2.25	13.25
8/5	C	7	2.25	2.75	16.25	0.25	0.5	0.25	1	1.25	2.75	22.5
8/5	C	8	2.5	8.25	9.75	0.75	0	0	1.5	2.25	6.25	22.5
8/7	C	9	1	3	1.25	0	0	0.25	6.5	0.5	6.5	11.5
8/5	C	10	4	1.5	7.25	0	0	0	1.5	0.75	1.75	11
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8/14	B	2	7.5	27.25	3.25	2.25	0.5	0	0.75	1	15.75	35
8/14	B	3	5	19	4.5	4.75	0.5	0	0.25	0.5	12.75	29.5
8/14	B	4	5.25	23	4.75	1.75	0.75	0	2	0.5	10.75	32.75
8/14	B	5	2.25	30.75	7.25	3	0.75	0	1.5	1.5	11.25	44.75
8/12	B	6	3.25	11.5	4.75	0.5	0.25	0	0.5	0	8.75	17.5
8/12	B	7	0.75	7.5	3.5	0	0.25	0	0.25	0	3.75	11.5
8/12	B	8	3.25	4	6.5	1	0	0	0.75	0.67	2.25	12.75
8/14	B	9	2.25	7.75	2	0.25	0	0	0.25	0	3	10.25
8/12	B	12	3	0	6.25	0	0	0	0.75	2.25	0	9.25
8/12	B	13	0	0	4.5	0	0	0	0	1	0.25	5
8/14	C	1	3.5	6.25	7	0.75	0.5	0	1.75	0.5	5.75	16.75
8/14	C	2	0.75	6	4.5	0	0	0	0.25	0	0.25	10.75
8/14	C	4	6.75	3.25	3.5	0.5	0	0	0.25	0.25	1.25	8
8/12	C	6	2.25	5	9.25	0.5	0.25	0	1	1.25	2.75	17.25
8/12	C	7	3.5	2.75	9.5	0	0.5	0.25	0.75	1.25	2.75	15
8/12	C	8	5	8.25	14.25	0.75	0	0	0.5	0.5	6.75	24.25
8/14	C	9	0.5	4.75	2.25	0	0	0	3	0.5	2.5	10.5
8/12	C	10	3.75	3.75	10.75	0.25	0	0	2.5	1	2.5	18.5

date	trtmt	farm	lygus	bige-eyed bugs	minute pirate bugs	damsel bugs	assassin bugs	ladybird beetles	lacewings	spiders	immature beneficials	total beneficials
8/21	B	1	3.25	8.75	4	1.5	0.25	0	0.25	1	6.5	15.75
8/21	B	3	3.75	11	3.25	0.75	0.25	0	0	0.25	5.25	15.5
8/21	B	4	3.5	8.5	2.75	0.5	0	0	0.5	0	4.5	12.25
8/21	B	5	5.5	11	6	2	0.5	0	0.5	0.25	6.25	20.75
8/19	B	6	4.75	9.25	4.5	0.75	0.25	0	0.25	0.75	5.75	16
8/19	B	7	11.75	5.5	3	0	0	0	0.5	0.5	2.25	9.5
8/19	B	8	8.5	5.75	5.5	0.5	0.25	0	0.5	1	2.5	13.5
8/19	B	9	2.25	8	3.75	0.75	1	0	0.75	0.5	4.25	14.75
8/21	B	12	3.25	0.5	5.75	0	0	0	1	0.75	3.25	8
8/21	B	13	0	0	5.25	0	0	0	0	0	0.25	5.25
8/21	C	1	3.5	10.75	4.5	0	0.75	0	0	1.75	4	19
8/21	C	4	8.25	4	10	0.5	0	0	1	0	4.5	15.5
8/19	C	5	3.25	6	4.75	1.75	0.25	0	0.5	5.5	3.25	18.75
8/19	C	6	3.75	4.25	12	0.5	0.5	0	0	0.5	1	17.75
8/19	C	7	6.25	2.75	10.25	1	0.25	0	0.25	2.25	4	16.75
8/19	C	8	7.25	4.75	8	0	0.25	0	0.25	1.5	1.5	14.75
8/19	C	10	2.75	0.75	4.75	0.5	0.5	0	0.5	2.25	1.75	9.25
8/26	B	1	6.75	19.25	7.75	1	0.75	0	0.5	1.25	12.25	30.5
8/26	B	2	5.5	15.5	5.25	1.25	0	0.25	0	1.5	7.25	24.25
8/26	B	3	3.25	7.25	6.5	2.75	0.5	0	0.25	0.75	7.5	18
8/26	B	4	1.5	11.25	2.5	1.25	0	0	0	1	6.25	15.5
8/26	B	5	4.25	14.5	9.25	5.25	0.75	0	0.5	2.75	12.5	34.25
8/26	B	6	11.25	19.25	6.5	0.5	0.5	0	0.25	0.5	9.75	27.75
8/28	B	7	4	8.75	9	0.25	0.75	0.25	0.75	0	5.25	20
8/28	B	8	5	13.5	10	0.25	0.75	0	0.5	0.5	9.5	25.5
8/26	B	9	6.75	14	3.75	2	0.5	0	0	0.5	4.25	21
8/28	B	12	6.75	0.5	10	0	0	0	0.75	1.25	2	12.75
8/28	B	13	0.5	0.25	13.5	0	0	0	0.25	0	1	14
8/26	C	1	2.5	5.75	4.75	0	0.25	0.25	0	0.25	3.25	11.5
8/26	C	4	11	3.75	12.5	2	0.5	0	0	0.75	7.75	19.5
8/28	C	5	6	4.25	9.75	0	0.75	0.5	0	0.75	3.75	16
8/26	C	6	4.25	2.25	20.5	0	1.25	0	0	1.25	7.5	25.25
8/28	C	7	8.75	4.75	23.75	0	0.75	0	0	0.75	11.25	30
8/28	C	8	3.5	3.75	6.5	0.25	0.5	0	0	1	4.25	11.5
8/28	C	10	0	0	3.25	0	0	0	0	0	0.5	3.25
8/28	C	12	4.75	0.75	19.75	0	0	0	0.25	2.25	7	23.25
8/28	C	13	1	0.25	5.75	0	0	0	0	0	0	6

date	trtmt.	field	height	nodes	vegetative nodes	fruiting branches	nodes above white flower	top 5 retent.	bottom 5 retent.
6/6	B	1	1.80	2.40					
6/9	B	2	2.10	3.85					
6/9	B	3	2.38	3.70					
6/10	B	4	1.48	2.60					
6/11	B	6	2.05	4.35					
6/11	B	7	1.65	2.95					
6/11	B	8	1.98	3.90					
6/10	B	9	1.38	2.95					
6/19	B	11	2.45	4.45					
6/19	B	12	3.98	7.35					
6/13	C	2	1.20	1.85					
6/13	C	3	1.70	2.20					
6/13	C	6	1.78	3.05					
6/5	C	7	2.55	3.95					
6/13	C	8	1.70	2.90					
6/5	C	9	1.65	2.70					
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6/25	B	1	6.78	6.85	4.20	1.40			
6/25	B	2	6.58	8.00	4.65	3.35			3.33
6/25	B	3	8.50	7.95	4.55	2.75			3.33
6/25	B	4	5.30	6.55	3.65	1.55			
6/25	B	5	2.78	3.40	0.00	0.00			
6/25	B	9	5.03	6.10	3.95	0.95			
7/10	B	11	12.88	11.45	5.25	6.20			
6/25	B	12	7.13	9.20	4.65	4.50		2.00	4.10
6/25	B	13	8.73	9.95	5.10	4.85		1.00	4.20
6/25	B	14	5.98	6.85	2.70	4.09		4.00	3.64
7/10	C	11	12.65	11.20	4.80	6.40			
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7/14	B	1	17.43	11.40	3.00	8.40		4.00	2.55
7/14	B	2	14.18	12.00	3.65	7.90		3.25	1.30
7/14	B	3	17.73	12.05	5.65	6.40		3.50	1.93
7/14	B	4	14.48	11.50	5.15	6.35		4.00	3.25
7/14	B	5	10.03	8.50	4.75	4.00			3.00
7/14	B	6	13.48	12.95	5.50	7.32	7.50	3.00	3.95
7/14	B	7	12.45	10.50	4.50	6.00	5.00		4.35
7/14	B	8	15.45	13.10	5.65	7.45		5.00	3.28
7/14	B	9	15.55	12.15	5.50	6.60			3.45
7/14	B	12	17.85	14.95	5.50	9.45	7.15	2.89	4.55
7/14	B	13	21.30	14.40	5.50	8.90	6.90	4.25	3.65
7/14	B	14	21.40	15.65	5.25	10.15	7.58	3.93	4.25
7/14	C	3	7.08	7.75	5.85	1.90			1.00
7/14	C	4	19.48	12.20	5.40	7.30	8.50	3.00	3.75
7/14	C	6	19.50	11.80	4.60	7.20	8.00	5.00	4.05

date	trtmt.	field	height	nodes	vegetative nodes	fruiting branches	nodes	top 5 retent.	bottom 5 retent.
							above white flower		
7/30	B	1	29.35	5.45	11.60	11.60	7.22	3.65	1.70
7/30	B	2	26.40	16.90	5.80	11.10	8.14	3.93	1.70
7/30	B	3	28.95	16.80	6.65	10.05	8.29	4.18	2.30
7/30	B	4	26.23	15.65	5.50	10.15	7.71	3.36	2.70
7/31	B	5	22.43	13.00	5.30	7.70	7.33	5.00	3.32
8/5	B	6	24.43	17.55	5.70	11.89	4.33	4.67	2.16
8/5	B	7	23.25	15.55	5.20	10.35	6.25	4.31	2.84
8/5	B	8	29.70	17.70	5.45	12.25	6.67	4.18	2.75
8/5	B	9	28.20	16.35	5.55	10.80	6.67	4.41	2.30
7/31	C	1	23.48	14.10	5.20	9.00	6.25	3.67	2.30
7/31	C	2	26.33	14.10	4.80	9.30	6.43	4.40	2.90
7/31	C	3	11.18	11.35	6.25	5.10	5.50		3.38
8/5	C	4	31.70	16.55	5.30	11.25	4.60	4.47	3.15
8/5	C	5	28.35	16.70	5.95	10.75	5.38	4.05	3.20
8/5	C	6	32.48	15.85	4.85	11.00	7.13	4.47	3.50
8/6	C	8	26.80	15.85	4.75	11.10	5.44	4.17	3.20
7/24	C	9	17.95	12.45	5.50	6.95	9.00	4.50	4.06
8/6	C	10	27.75	16.30	4.70	11.60	5.57	4.53	2.65
8/13	B	1	33.78	19.15	5.60	13.55	5.00	3.74	1.60
8/13	B	2	33.90	19.90	5.45	14.45	6.14	4.00	1.05
8/13	B	3	33.80	18.20	5.70	12.50	4.50	3.05	0.65
8/13	B	4	35.45	19.05	5.35	13.50	5.83	3.70	1.60
8/6	C	8	26.80	15.85	4.75	11.10	5.44	4.17	3.20
8/8	C	9	25.05	15.05	5.25	9.60	5.13	4.75	3.75
8/6	C	10	27.75	16.30	4.70	11.60	5.57	4.53	2.65

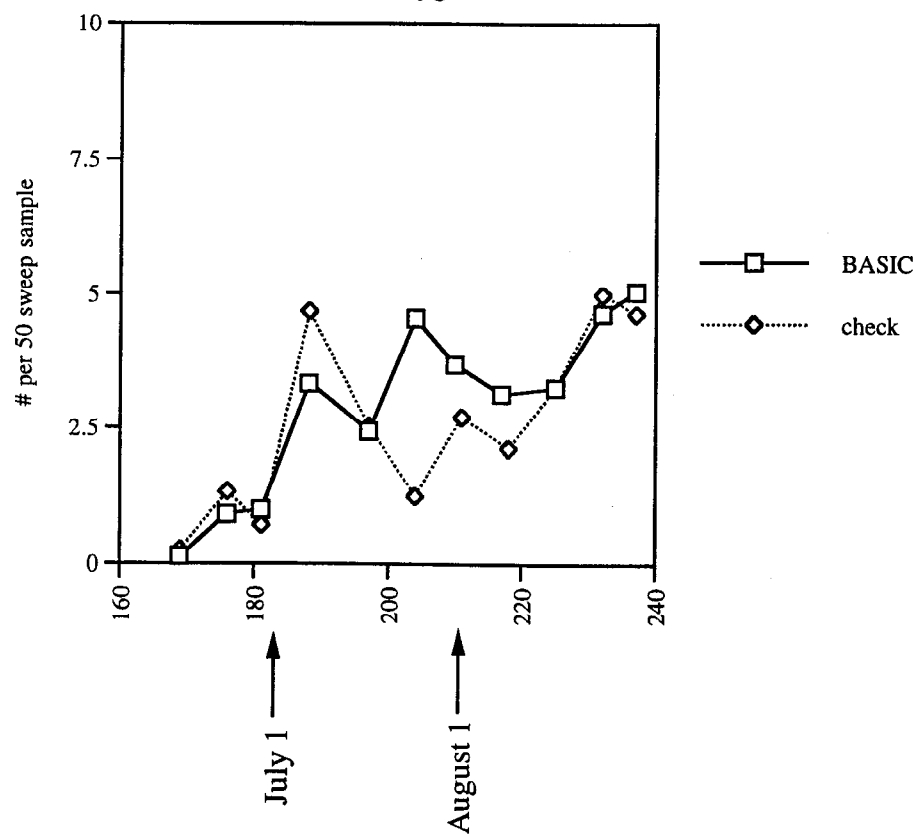
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<u>date</u>	<u>trtmt</u>	<u>field</u>	<u>mite</u> <u>rank</u>	<u>% mite</u> <u>infestation</u>	<u>mite</u> <u>eggs</u>	<u>thrips</u> <u>rank</u>	<u>aphid</u> <u>rank</u>	<u>minute</u> <u>pirate</u> <u>bugs</u>	<u>lacewing</u> <u>eggs</u>	<u>bige-eyed</u> <u>bug eggs</u>	<u>total</u> <u>beneficials</u>
6/6	B	1	1.25	25.00	1.20	1.30	1.05	0.00	0.00	0.00	0.00
6/9	B	2	1.15	15.00	1.10	1.15	1.00	0.00	0.00	0.00	0.00
6/9	B	3	1.05	5.00	1.05	1.45	1.00	0.00	0.00	0.00	0.00
6/10	B	4	1.15	15.00	1.10	1.10	1.15	0.00	0.00	0.00	0.00
6/11	B	6	1.20	20.00	1.00	1.25	1.00	0.00	0.00	0.00	0.00
6/11	B	7	1.55	50.00	1.20	1.25	1.00	0.00	0.00	0.00	0.00
6/11	B	8	1.20	20.00	1.20	1.20	1.00	0.00	0.00	0.00	0.00
6/10	B	9	1.10	10.00	1.05	1.25	1.00	0.00	0.00	0.00	0.00
6/19	B	11	1.40	40.00	1.45	1.35	1.00	0.00	0.00	0.00	0.00
6/19	B	12	1.25	25.00	1.15	1.25	1.00	0.00	0.00	0.00	0.00
6/11	C	2	1.00	5.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00
6/13	C	3	1.50	45.00	1.45	1.20	1.00	0.00	0.00	0.00	0.00
6/10	C	6	1.47	45.00	1.32	1.37	1.21	0.00	0.00	0.00	0.00
6/12	C	7	1.00	0.00	1.00	1.75	1.00	0.00	0.00	0.00	0.00
6/12	C	8	1.25	25.00	1.20	1.45	1.00	0.00	0.00	0.00	0.00
6/13	C	9	1.70	55.00	1.55	1.10	1.05	0.00	0.00	0.00	0.00
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6/25	B	1	2.20	80.00	1.80	1.65	1.00	0.00	0.00	0.15	0.15
6/25	B	2	2.40	85.00	1.85	1.80	1.05	0.05	0.00	0.00	0.05
6/25	B	3	1.55	50.00	1.50	1.50	1.00	0.00	0.00	0.05	0.05
6/25	B	4	1.75	45.00	1.65	1.75	1.05	0.10	0.00	0.00	0.05
6/25	B	5	1.30	30.00	1.30	1.25	1.00	0.00	0.00	0.00	0.05
6/25	B	9	1.95	80.00	1.80	1.90	1.00	0.00	0.00	0.10	0.10
7/10	B	11	2.20	85.00	1.75	1.55	1.05	0.65	0.00	0.10	1.25
6/25	B	12	1.25	25.00	1.25	1.35	1.00	0.00	0.00	0.00	0.00
6/25	B	14	1.10	5.00	1.05	1.10	1.05	0.05	0.00	0.00	0.05
7/10	C	11	1.05	5.00	1.05	1.00	1.00	0.00	0.00	0.00	0.00
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7/14	B	1	1.95	95.00	1.95	1.25	1.00	0.00	0.00	0.25	0.25
7/14	B	2	2.45	100.00	1.95	1.65	1.00	0.00	0.10	0.00	0.10
7/14	B	3	2.15	95.00	1.95	1.80	1.00	0.20	0.05	0.10	0.35
7/14	B	4	2.35	45.00	1.95	2.30	1.05	0.10	0.00	0.45	0.10
7/14	B	5	1.90	75.00	1.75	1.90	1.00	0.05	0.00	0.15	0.20
7/14	B	6	1.70	55.00	1.55	1.70	1.05	0.05	0.00	0.25	0.30
7/14	B	7	1.25	20.00	1.15	1.05	1.00	0.00	0.00	0.00	0.05
7/14	B	8	1.70	60.00	1.60	2.10	1.00	0.15	0.00	0.20	0.35
7/14	B	9	2.55	90.00	1.90	2.25	1.00	0.10	0.05	0.15	0.30
7/14	B	12	1.25	20.00	1.20	1.00	1.00	0.00	0.05	0.00	0.10
7/14	B	13	1.05	5.00	1.00	1.00	1.00	0.10	0.00	0.00	0.10
7/14	B	14	1.10	10.00	1.10	1.15	1.00	0.00	0.15	0.00	0.15
7/14	C	3	1.85	75.00	1.60	1.10	1.00	0.00	0.00	0.00	0.05
7/14	C	4	1.80	65.00	1.65	1.45	1.10	0.00	0.00	0.00	0.00
7/14	C	6	1.00	0.00	1.00	1.05	1.00	0.00	0.05	0.00	0.05
7/24	C	7	1.05	5.00	1.05	1.00	1.00	0.00	0.10	0.00	0.10
7/24	C	8	1.10	10.00	1.10	1.10	1.00	0.00	0.00	0.00	0.00
7/24	C	9	1.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00

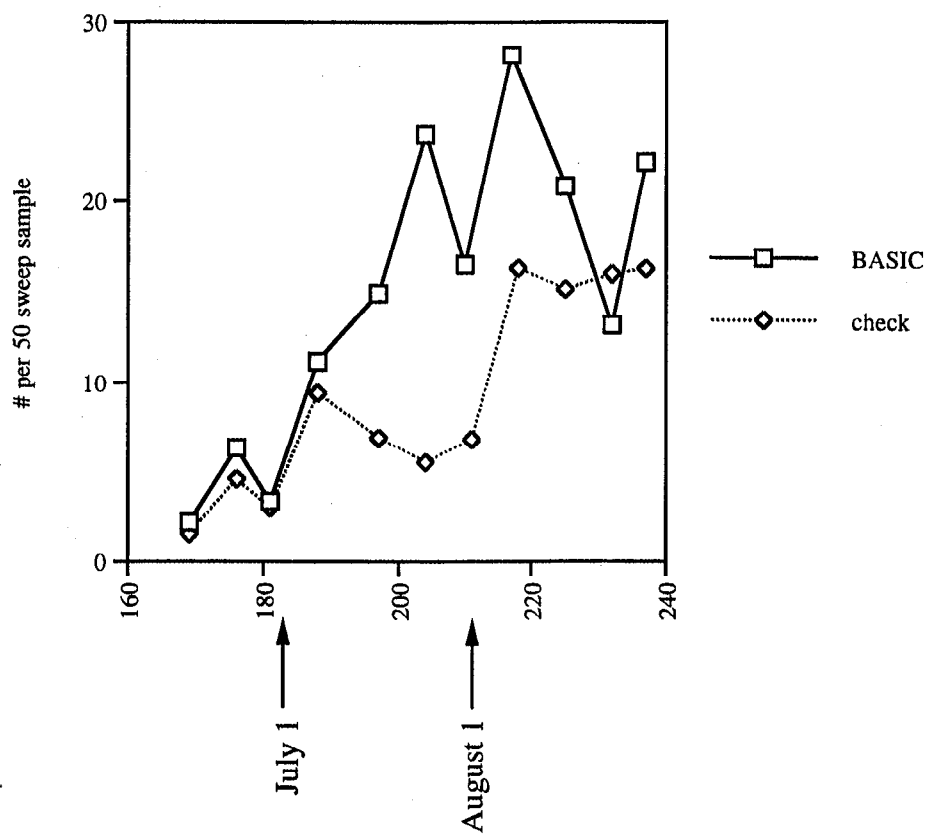
<u>date</u>	<u>trtmt</u>	<u>field</u>	<u>mite</u> <u>rank</u>	<u>% mite</u> <u>infestation</u>	<u>mite</u> <u>eggs</u>	<u>thrips</u> <u>rank</u>	<u>aphid</u> <u>rank</u>	<u>minute</u> <u>pirate</u> <u>bugs</u>	<u>lacewing</u> <u>eggs</u>	<u>bigeyed</u> <u>bug eggs</u>	<u>total</u> <u>beneficials</u>
7/30	B	1	1.65	65.00	1.40	1.75	1.00	0.30	0.10	0.20	0.60
7/30	B	2	1.50	50.00	1.30	1.50	1.00	0.15	0.10	0.25	0.50
7/30	B	3	2.05	75.00	1.50	1.40	1.00	0.45	0.15	0.20	0.80
7/30	B	4	1.75	30.00	1.20	1.45	1.00	0.45	0.30	0.45	0.05
7/30	B	5	2.25	80.00	1.75	1.75	1.00	0.15	0.05	0.55	0.75
8/6	B	6	1.05	5.00	1.05	1.45	1.05	0.05	0.05	0.00	0.10
8/5	B	7	1.10	10.00	1.10	1.10	1.05	0.00	0.15	0.10	0.25
8/5	B	8	1.30	30.00	1.30	1.50	1.00	0.00	0.00	0.05	0.05
8/6	B	9	1.80	60.00	1.45	1.40	1.00	0.15	0.05	0.15	0.35
7/31	C	1	2.30	80.00	1.70	1.50	1.00	0.05	0.25	0.00	0.30
7/31	C	2	1.20	20.00	1.20	1.10	1.00	0.00	0.10	0.00	0.10
7/31	C	3	1.10	10.00	1.05	1.05	1.00	0.00	0.00	0.00	0.00
8/5	C	4	1.45	45.00	1.40	1.55	1.05	0.10	0.00	0.05	0.15
8/5	C	5	1.15	10.00	1.10	1.20	1.00	0.00	0.30	0.25	0.55
8/5	C	6	1.05	5.00	1.05	1.26	1.00	0.00	0.30	0.10	0.40
8/6	C	7	1.00	0.00	1.00	1.00	1.05	0.00	0.05	0.00	0.05
8/6	C	8	1.00	0.00	1.00	1.10	1.00	0.00	0.15	0.10	0.25
8/6	C	10	1.10	10.00	1.10	1.00	1.15	0.00	0.55	0.00	0.55
8/13	B	1	1.50	45.00	1.20	1.45	1.00	0.05	0.05	0.25	0.35
8/13	B	2	1.50	50.00	1.40	1.30	1.00	0.10	0.10	0.25	0.45
8/13	B	3	1.70	60.00	1.25	1.30	1.00	0.30	0.05	0.65	1.00
8/13	B	4	1.65	100.00	1.40	1.45	1.05	0.15	0.20	0.20	0.00
8/8	C	9	1.70	70.00	1.50	1.35	1.00	0.00	0.00	0.15	0.15

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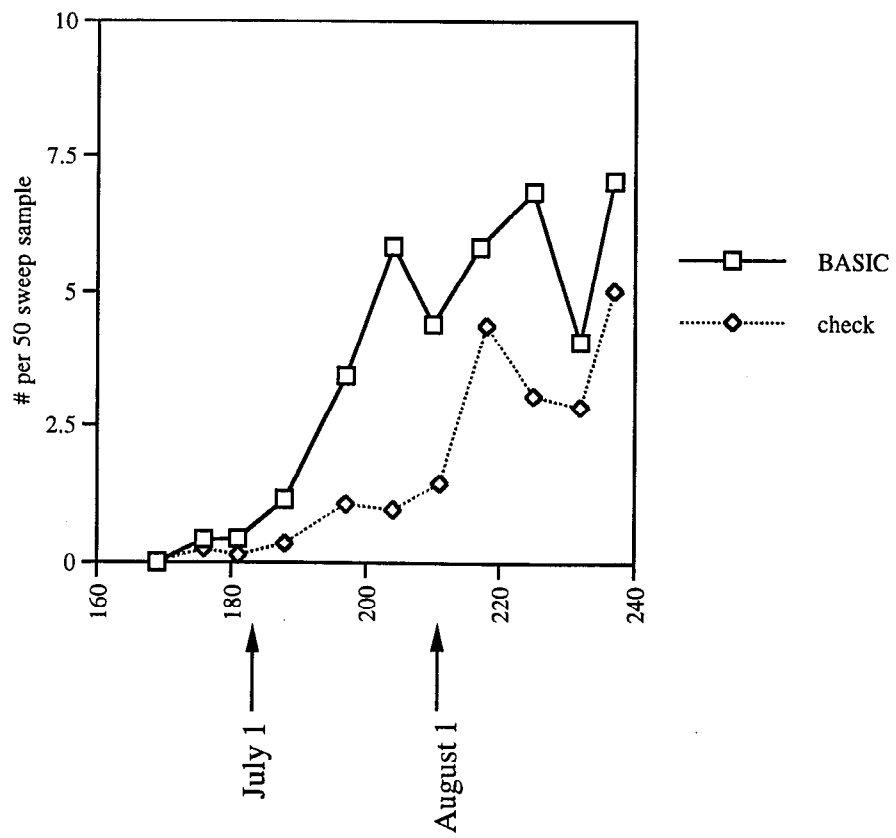
1998 BASIC Sweep Insects  
Total Lygus



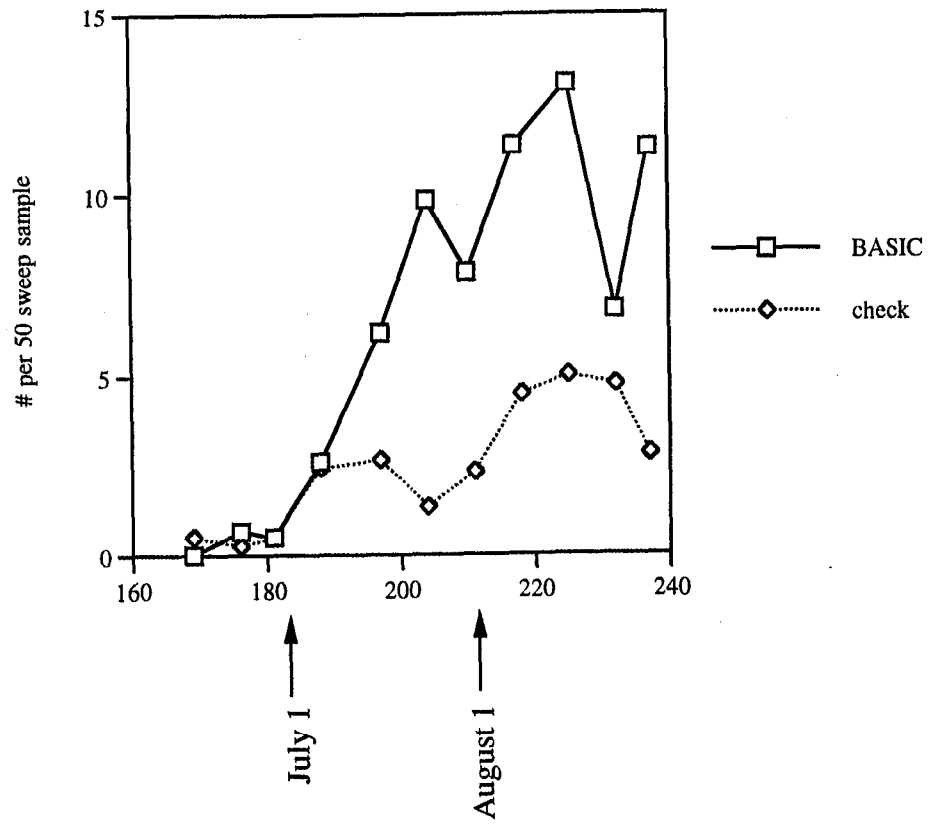
1998 BASIC Sweep Insects  
Total Natural Enemies



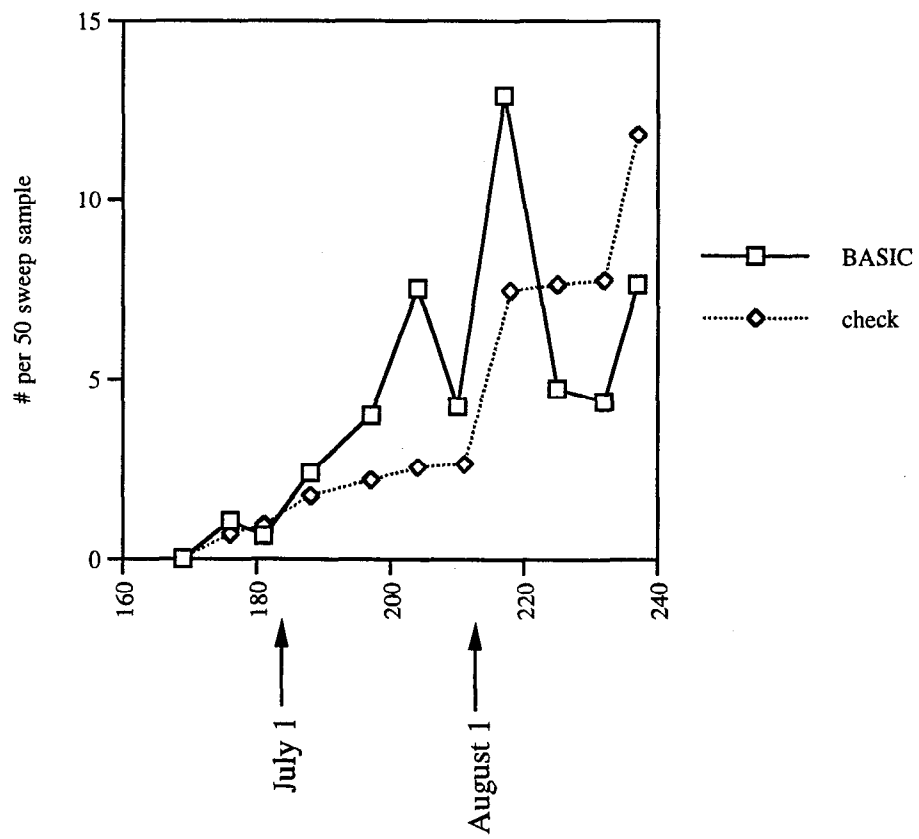
1998 BASIC Sweep Insects Total  
Juvenile Natural Enemies



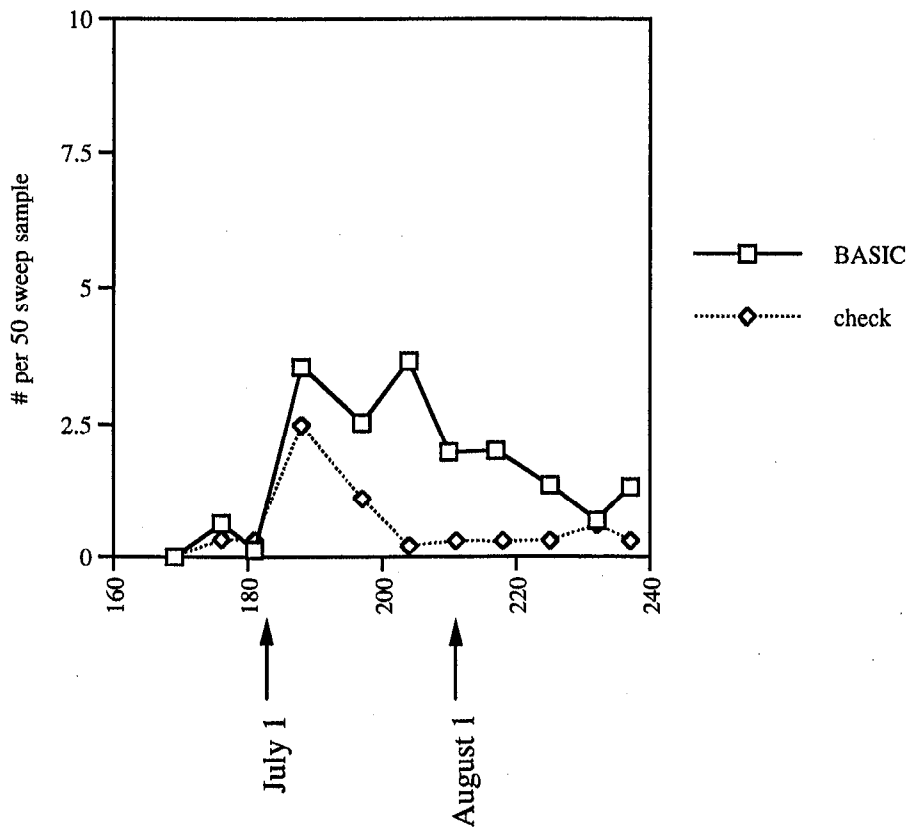
1998 BASIC Sweep Insects  
Total Big-eyed Bugs



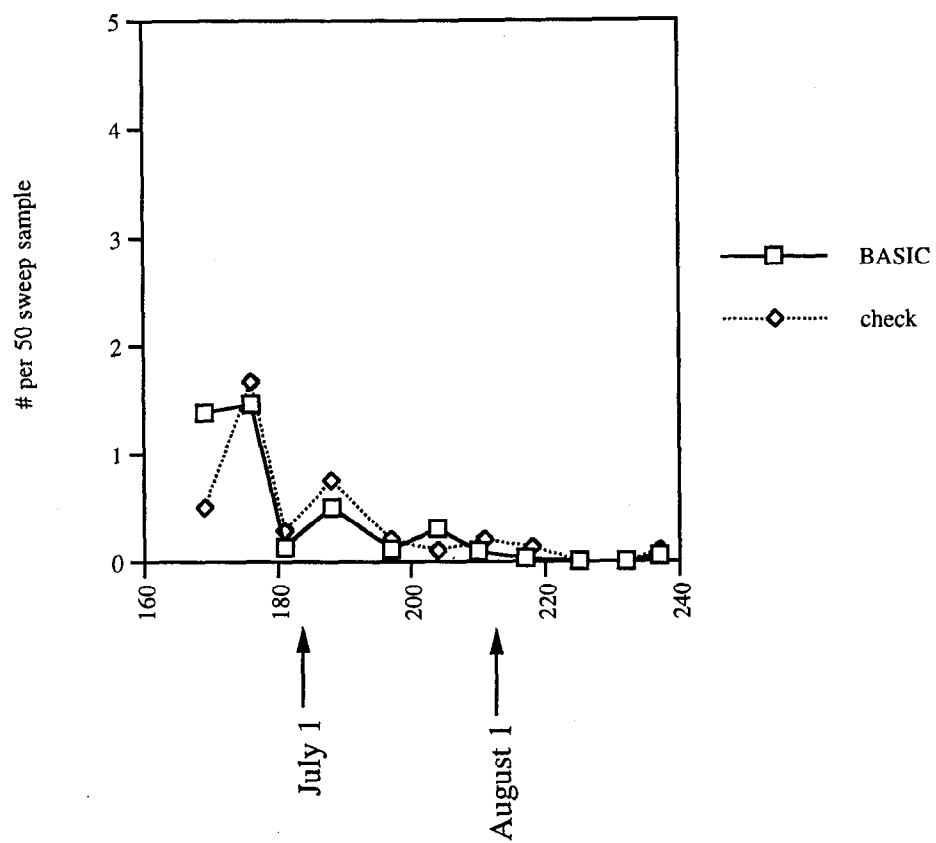
1998 BASIC Sweep Insects  
Total Minute Pirate Bugs



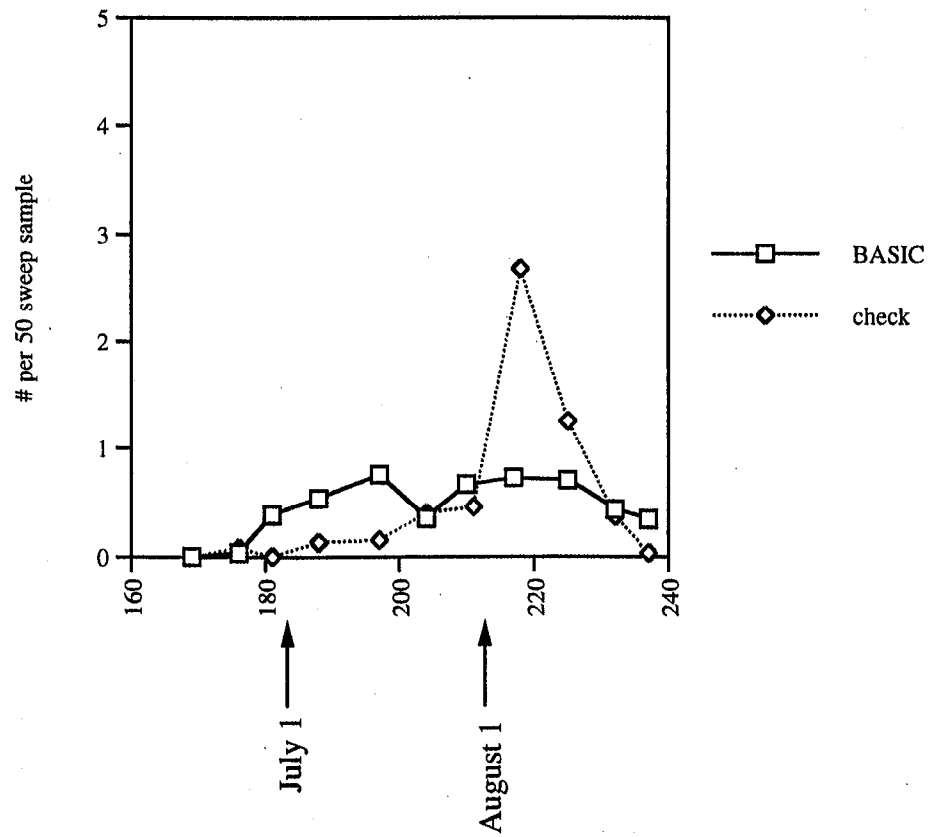
1998 BASIC Sweep Insects  
Total Nabids



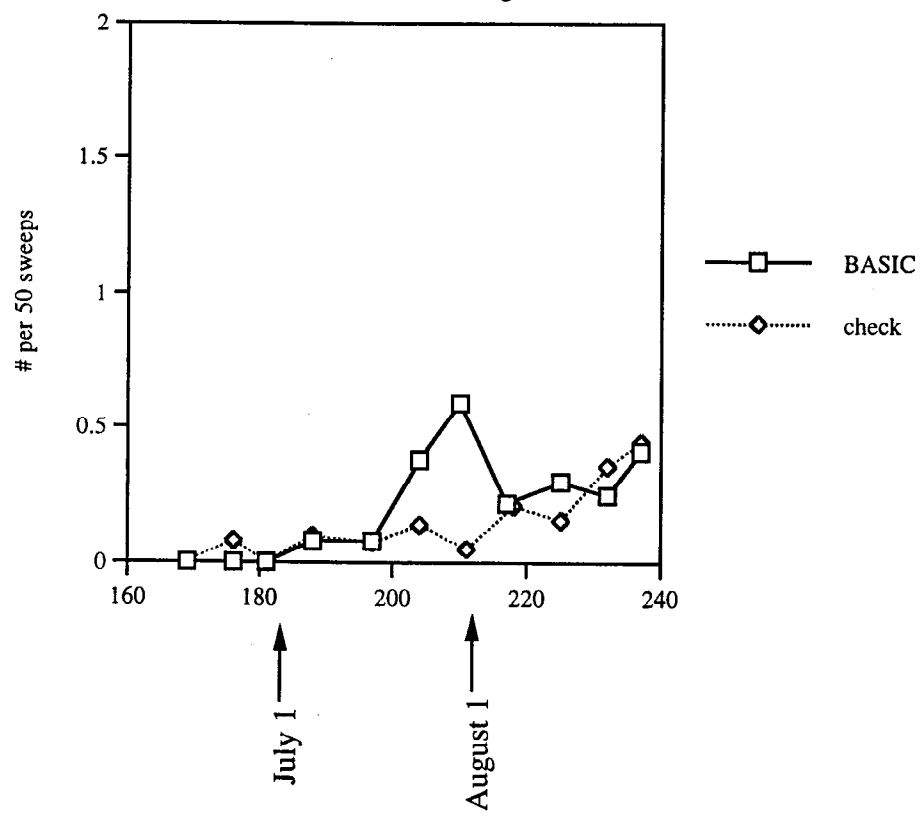
1998 BASIC Sweep Insects  
Total Lady Beetles



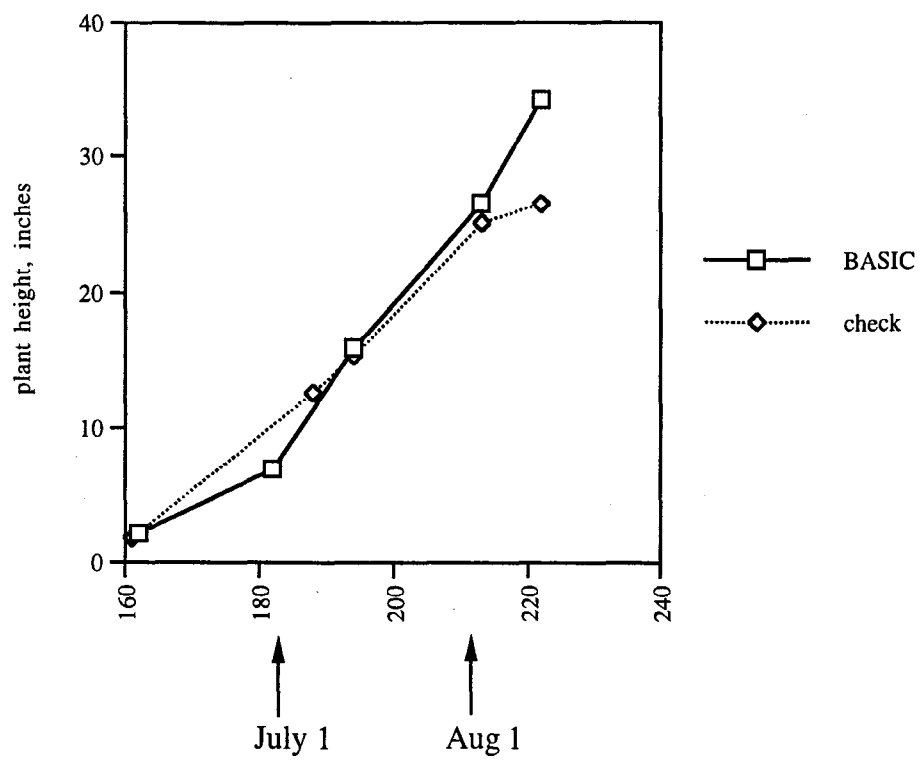
1998 BASIC Sweep Insects  
Total Lacewings



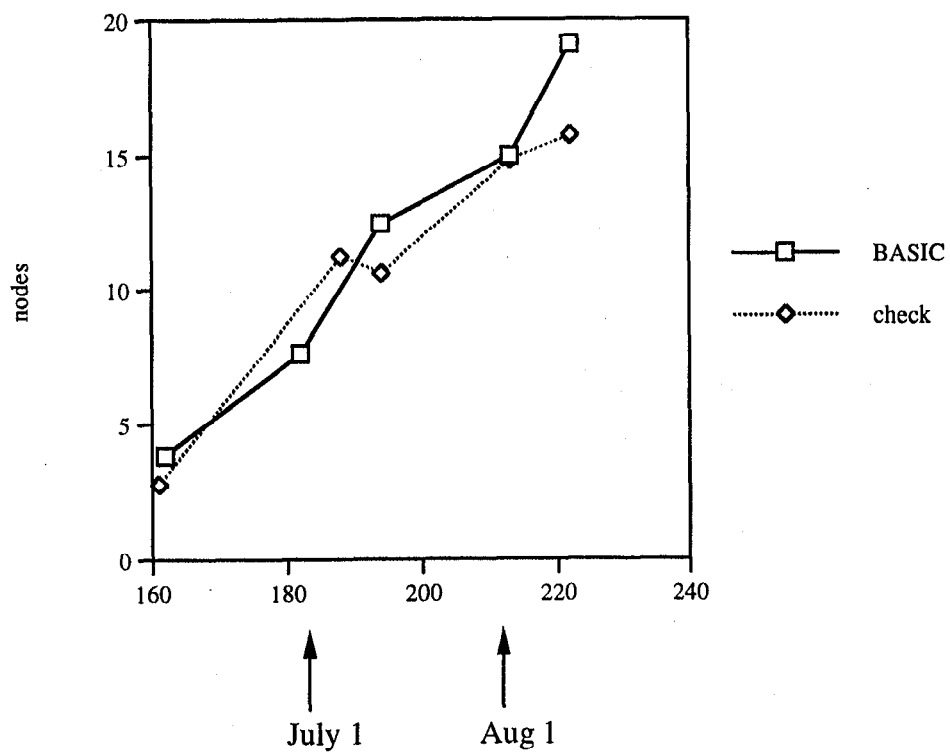
1998 BASIC Sweep Insects  
Total Assassin Bugs



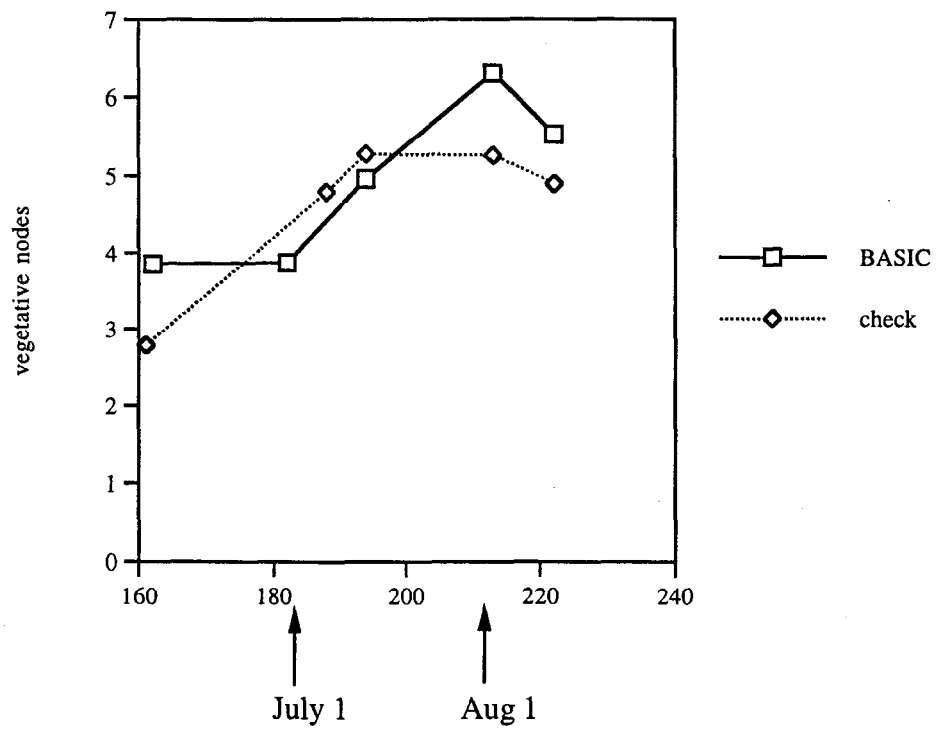
1998 BASIC Plant Maps  
plant heights



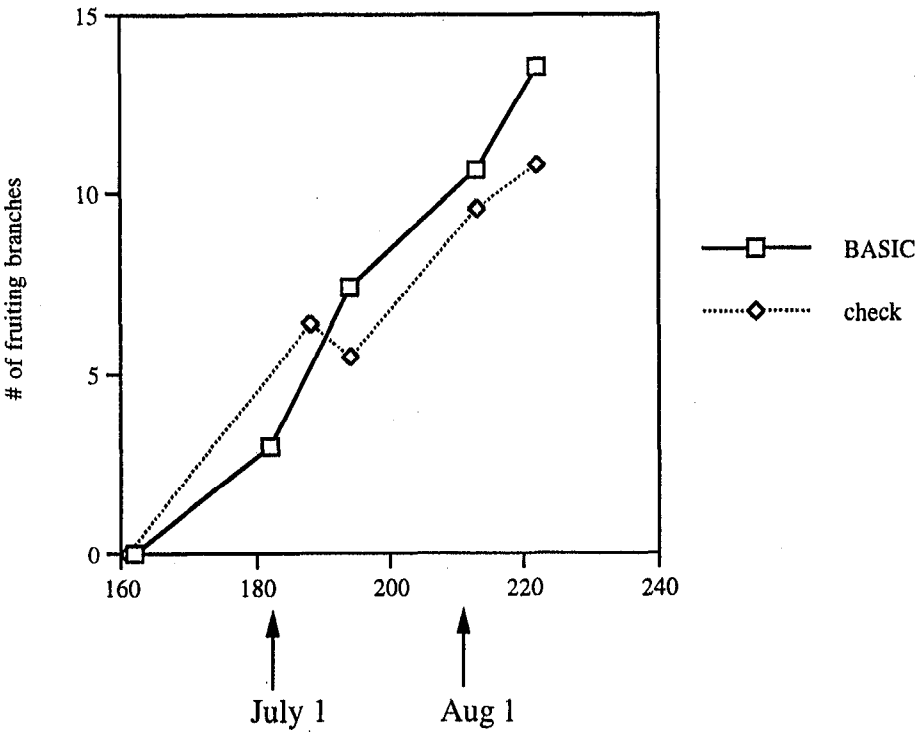
1998 BASIC Plant Maps  
nodes



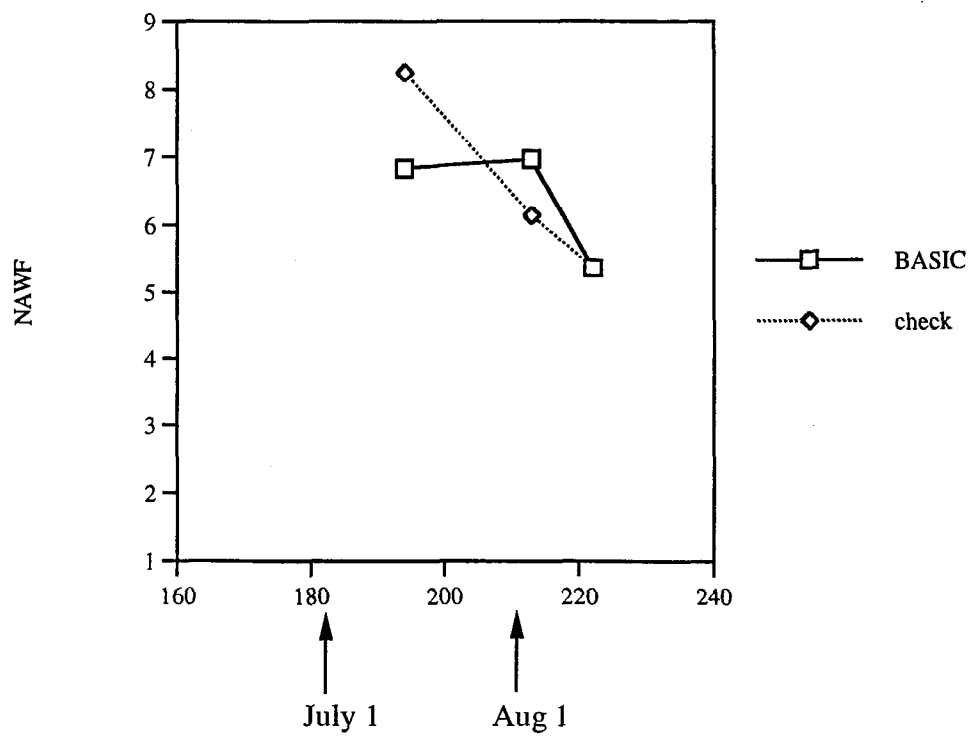
1998 BASIC Plant Maps  
vegetative nodes



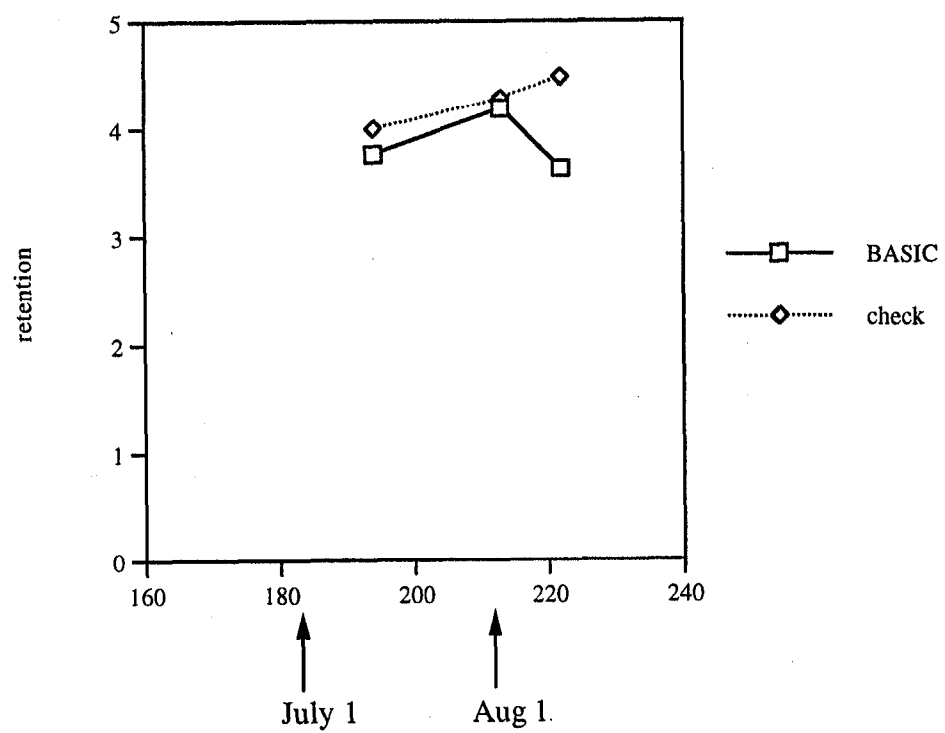
1998 BASIC Plant Maps  
fruiting branches



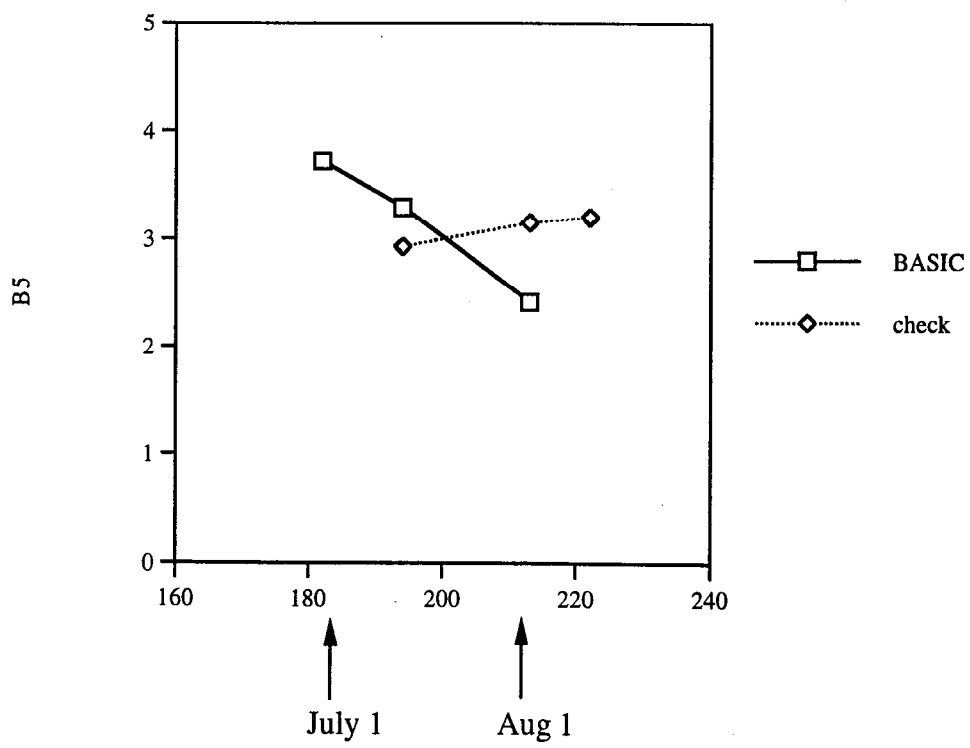
1998 BASIC Plant Maps  
Nodes above white flower



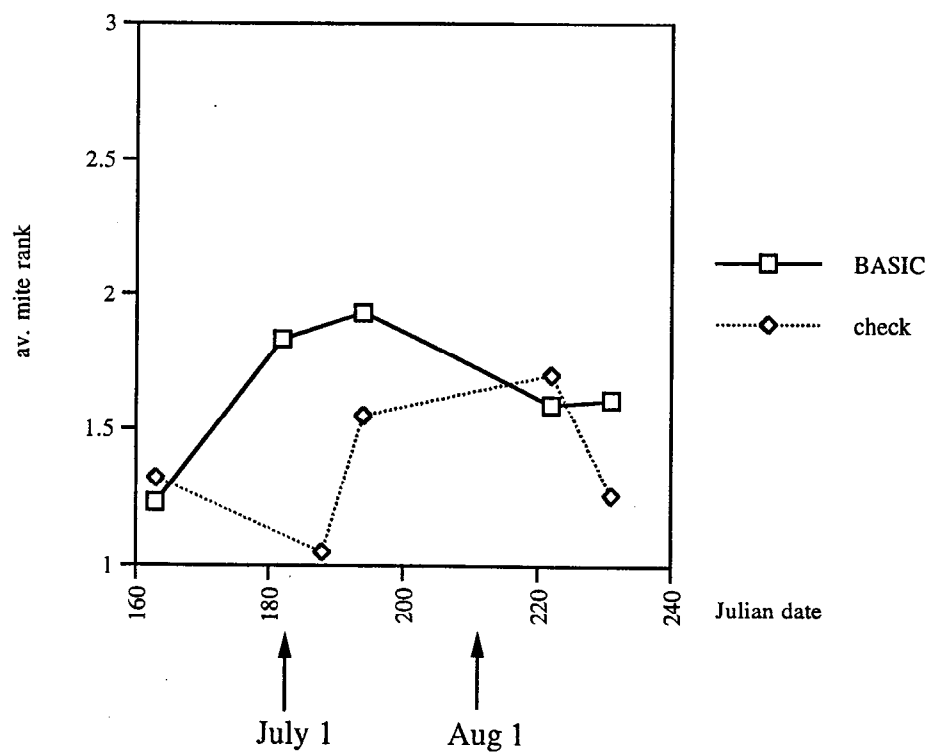
1998 BASIC Plant Maps  
Top 5 retention



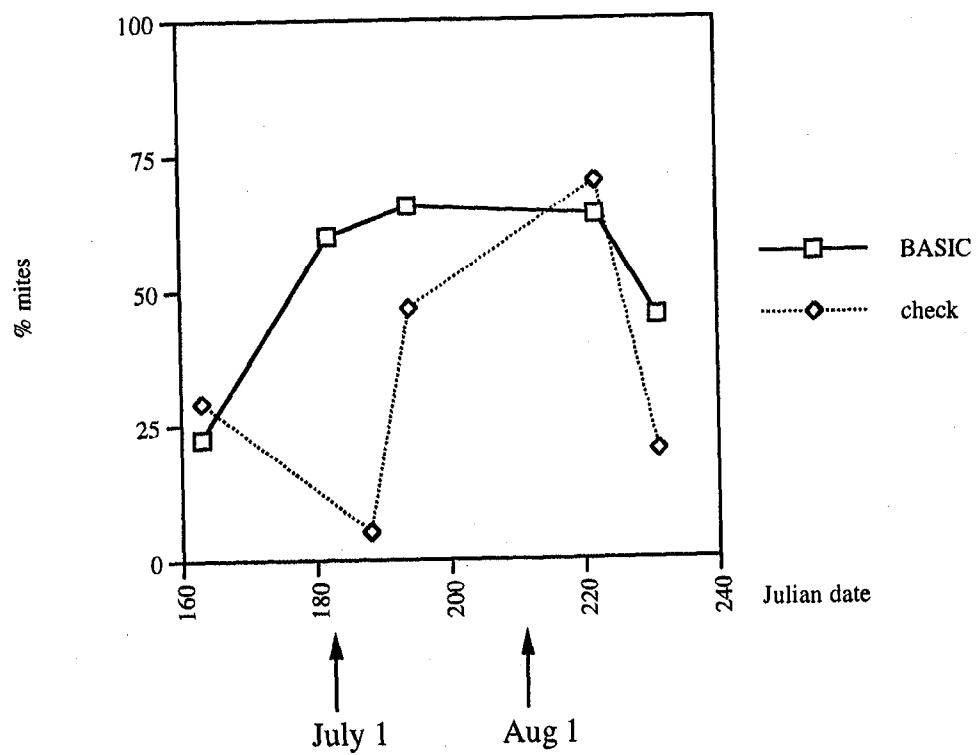
1998 BASIC Plant Maps  
Bottom 5 retention



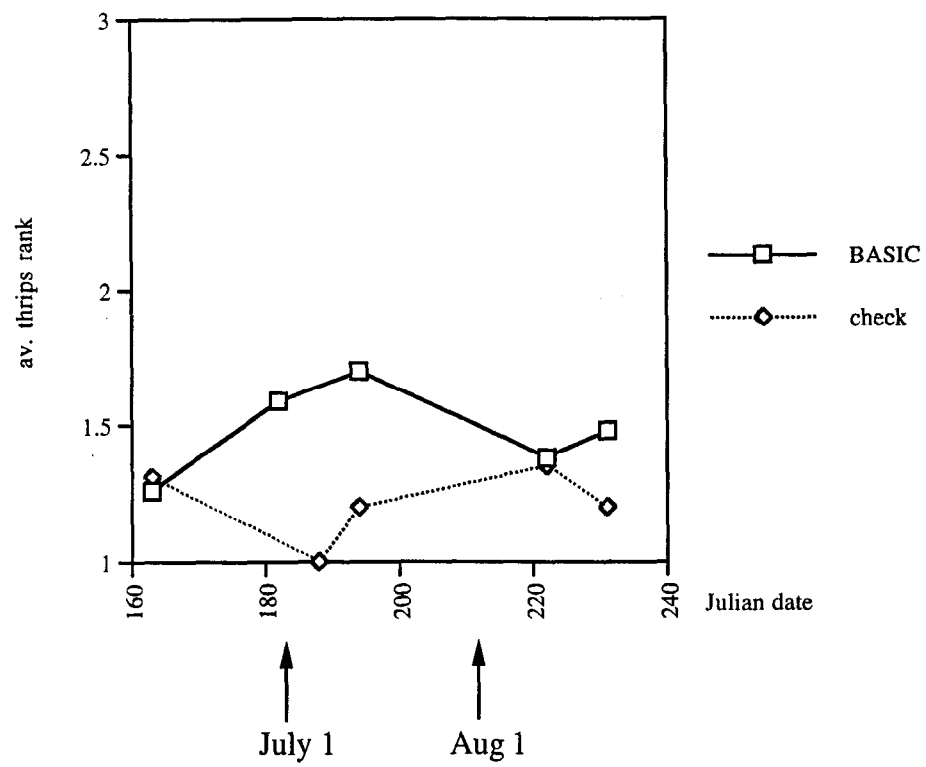
1998 BASIC Leaf insects  
Mites



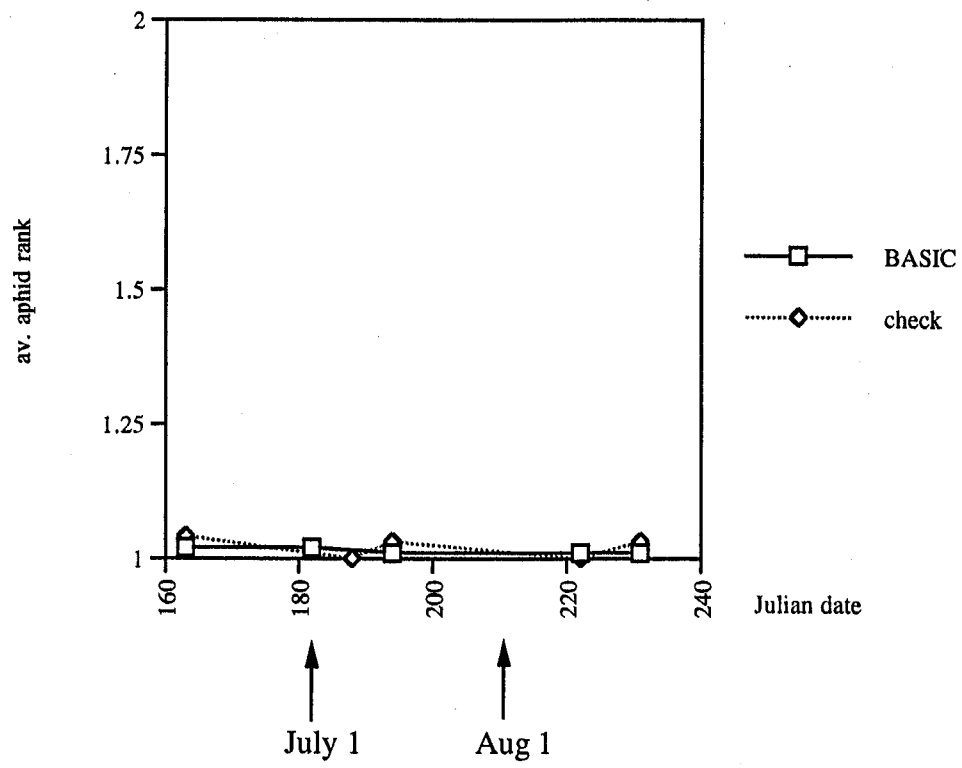
1998 BASIC Leaf Insects  
% mite infestation



1998 BASIC Leaf Insects  
Thrips



1998 BASIC Leaf Insects  
Aphids



1998 BASIC Leaf Insects  
Total Predators

